Final report

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Waste Management
Corporation

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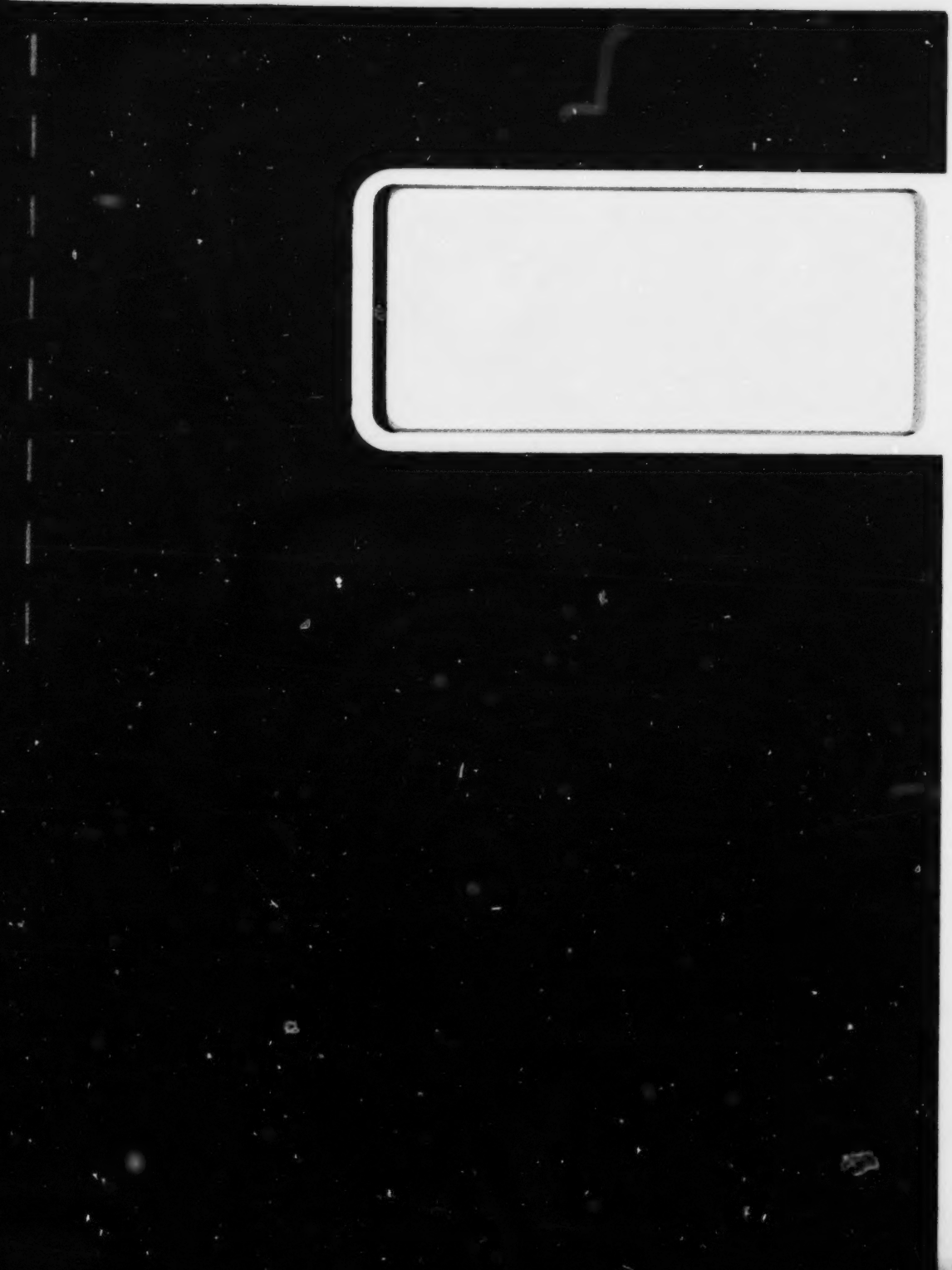

PILORUSSO
RESEARCH
ASSOCIATES INC.

BACKGROUND PAPER

TRANSPORTATION OF SPECIAL WASTES IN ONTARIO

Prepared for:

THE ONTARIO WASTE MANAGEMENT CORPORATION

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November 21, 1984

Dr. Barry D. Mitchell
Director - Corporate Planning
and Development
Ontario Waste Management Corporation
2 Bloor Street West
Toronto, Ontario
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Dear Mr. Mitchell:

We are pleased to submit our report, "Transportation of Special Wastes in Ontario".

The report is based on a survey of carriers of liquid industrial waste that was carried out in the spring of 1983. Although the report was substantially complete by September 1983, it incorporates all editorial changes that were suggested by OWMC to the current date.

Yours very truly,

F. Pilorusso

F. Pilorusso

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EXECUTIVE SUMMARY

S.1 PURPOSE OF THE REPORT

The research described in this report is a preliminary investigation of three issues involving special waste transportation. Further, the research provides descriptive information on two aspects of special waste transportation.

Issues addressed are:

- The transportation mode most likely to be used for special waste;
- The estimated number of spills of special waste during transportation; and
- The estimated cost of transporting special waste to treatment.

Data describe:

- The existing liquid industrial waste transportation industry; and
- Existing and proposed legislation affecting the transportation of special waste.

S.2 SCOPE AND METHOD OF STUDY

The question of the appropriate transportation mode for special waste was determined through an analysis of the relevant costs and risks of the various modes.

The estimated number of spills of special wastes was determined based upon:

- The probability of a spill during loading and unloading and the probability of a spill during transport, either as a result of an accident or other mechanism such as equipment failure; and

- The appropriate measure of exposure to these probabilities. In the case of in-transit spills, the measure of exposure is vehicle kilometers travelled; while for loading and unloading spills, the measure of exposure is the number of loadings and unloadings.

In order to calculate exposures, it was necessary to determine:

- Volumes of special wastes transported;

- Typical shipment patterns in terms of size of shipment; and

- Distances travelled.

Total annual costs for transporting special waste were also determined, based upon total distance and time required for travel. These were determined by:

- Shipment patterns in terms of shipment size, equipment type, loading and unloading characteristics;

Then, estimated costs were calculated, based on pricing criteria.

A critical component of both estimates is the estimated annual number of shipments. This was determined by dividing the total quantities to be transported by the estimated average shipment size.

Interviews of carriers of liquid industrial waste provided data, previously not publicly available, for estimating the probability of spills and transportation costs. These

interviews were conducted with carriers who collectively transported over 80 percent of the liquid industrial waste moved in Ontario on the waybill in 1982. Personal interviews were conducted with 19 carriers, and telephone interviews with a further 21.

The interviews also provided information on company history, size, degree of diversification, operating characteristics, training programs and equipment.

Current and proposed legislation were collected from the relevant government departments.

S.3 PREMISES AND POSTULATES

S.3.1 OWMC DATA

OWMC provided:

- For modelling purposes only, low (150,000 tonnes), medium (300,000 tonnes) and high (500,000 tonnes), estimates of special waste to be transported annually;
- An assumed configuration of the treatment facility, i.e. a fully integrated treatment/disposal site; and
- A hypothetical location for the treatment facility and six transfer stations.

S.3.2 ASSUMPTIONS

The major assumptions made by the authors in order to carry out the work were:

- The proportion of special waste generation by waste stream, by municipal area, is constant, regardless of total special waste quantities being considered;
- The practices of the current liquid industrial waste carriers can be extrapolated to describe the future movements of liquid special waste;

- Special waste would be transported from all parts of the province to one central treatment facility; and

- Efficient transportation practice would lead to consolidation of loads, and result in a reduced number of shipments for areas 1.5 hours or more travel time from the treatment site.

5.4 DATA USED AND THEIR LIMITATIONS

The selection of the transportation mode was based on:

- Data on relevant risks and costs, from the literature; and

- Data on rail costs provided by rail companies.

Estimates of transportation spill probabilities and transportation costs are developed from the interview data. These data are specific to the movement of waste in Ontario and, as such, are more relevant than those found in the literature. However, the literature in these areas was reviewed, as well.

Average liquid shipment sizes were estimated from historic records from the Ministry of the Environment. Average solid shipment size estimates, where made, are based upon industry practices.

Descriptive data for the transportation industry were gathered through the interview process, and legislation data were collected from relevant government departments. There are no alternative sources for these data.

5.5 STRUCTURE OF THE REPORT

The report structure follows the process used to determine the project outputs, in that:

Chapter 2 determines the preferred transportation mode;

Chapter 3 develops the estimates of shipments, travel time and distance to be used;

Calculating spill probabilities and estimating the number of transportation spills in Chapter 4;

Chapter 5 describes the liquid industrial waste transportation industry, whose pricing policies are used;

Chapter 6 develops estimates of transportation costs; and

Chapter 7 outlines existing and proposed legislation that will affect the transportation of special wastes.

S.6 MAJOR FINDINGS

S.6.1 TRANSPORTATION MODE

Currently, virtually all wastes are transported by truck, although in theory they could be transported by any of the generic transportation modes.

Air, marine and pipeline modes are not practical for reasons of cost, lack of infrastructure and, in the cases of marine and pipeline, insufficient quantities of special wastes to make them cost-effective.

Rail transportation is most attractive for large volume movements. However, there is not sufficient volume in most of the special waste streams to achieve transportation economies of rail. For those special wastes where volumes are sufficient, rail costs remain higher than for truck, although this premium may be reduced through consideration of factors favourable to rail transportation during site selection.

As a result of these considerations, the truck mode is used in this analysis.

5.6.2 ESTIMATES OF SPILLS DURING TRANSPORTATION

The estimated average annual number of spills for the low volume scenario is between 3 and 4; 7 spills for the medium scenario; and, for the high volume scenario, 12. (A "spill" in this context refer to any spill of special wastes where, because of the nature of the material and the amount spilled, special efforts are required to clean up the material and restore the spill area to its former state.) These estimated numbers of spills are roughly equally split between those that occur in transit and those that occur during loading and unloading.

The estimates of the average annual number of spills are based on disaggregated length and accident rate data for each of the road links in the network used to transport the special wastes. In the aggregate spill probabilities and total distances travelled for loaded trucks are as follows:

- Estimated spill probabilities of approximately: 0.4 spill as a result of a motor vehicle accident per million vehicle kilometres travelled (VKT); 1 spill in transit as a result of other causes per million VKT; and 1 spill per 10,000 loadings and 1 spill per 10,000 unloadings, as calculated from the survey data;

combined with:

- Estimates of 1.1 million VKT annually for the low volume scenario, 2.2 million VKT annually for the medium volume scenario, and 3.6 million VKT annually for the high volume scenario;

which represents:

- The number of shipments per municipal area multiplied by the respective distances to transfer stations and the treatment facility, as appropriate.

Total travel distances were determined as follows:

- Special waste quantities by municipal area divided by average shipment size, which resulted in shipment estimates of approximately 9,000, 17,000 and 29,000 annually for the low, medium and high volume scenario respectively; and

- The length of the road links making up the routes from the municipal areas to the transfer stations and the treatment facility.

The arrival ratio of trucks carrying special wastes at the treatment facility are estimated to be 37, 70 and 115 daily for the low, medium and high volume scenario respectively, assuming 250 working days per year.

The shipments described above represent approximately 95 percent of the special wastes in the three volume scenarios. The missing volumes are comprised of: 4 percent of the total special wastes represented by solids for which no average shipment size could be calculated, and a further one percent of total special wastes that are generated at non specific sites (i.e. the estimates for regional generation).

5.6.3 THE LIQUID INDUSTRIAL WASTE TRANSPORTATION INDUSTRY

Interviews with liquid industrial waste carriers provided data that:

- Indicated the majority of carriers, while having been in business for several years, are relatively small (75 percent have 25 or fewer employees);

- Most of the carriers (76 percent) were involved in activities other than liquid industrial waste transportation;

- Carriers estimated that 95 percent of their movements were bulk shipments; and

- The majority of carriers had a driver training program, but there does not appear to be a standard, accepted approach to driver training.

S.6.4 TRANSPORTATION COSTS

Current (May 1983) industry pricing policy is to determine total price charged based upon time required as opposed to distance or volume charges. This practice reflects the high proportion of loading and unloading time relative to the travel time (i.e. distance travelled). There are also no backhaul charges at this time - a further reflection of short travel distances.

Current charges are, on average, $72.00 per hour for tank trucks used to transport liquid industrial waste. Insufficient data were collected to calculate a separate rate for equipment for transporting solid wastes. However, industry data suggests that it will not be significantly different than the rate for liquid industrial waste equipment. Based upon these rates, estimated annual for-hire transportation costs are $2.6, $4.9, and $8.2 million for the low, medium, and high volume scenarios respectively.

As haul distance increases from the current short distances, it is probable that carriers of special wastes will start to charge for empty backhauls. For-hire costs were calculated for all trips over 1.5 hours using the charge of $72.00 per hour, and including backhaul charges. Total estimated annual costs on this basis are $3.2 million for the low volume scenario, $6.1 million for the medium volume scenario, and $10.1 million for the high volume scenario.

S.6.5 RELEVANT LEGISLATION

Currently the Environmental Protection Act (EPA) of Ontario requires that movements of liquid industrial waste be recorded on the waybill system and be transported to authorized sites for disposal by licensed carriers.

Proposed federal regulations under the Transportation of Dangerous Goods Act will: stipulate requirements for equipment, record keeping and placarding; outline accident notification procedures, inspection procedures; and prescribe penalties for non compliance.

Proposed changes to provincial regulations under the EPA would result in: an increase in the type and number of wastes monitored under the waybill system currently

in place; requirements for the registration of waste generators; and assignment of responsibility and liability in the event of a spill.

Proposed regulations to the Ministry of Transportation and Communications' Dangerous Goods Transportation Act would apply federal transportation regulations to intraprovincial movements of dangerous goods.

S.6.6 OTHER FINDINGS

Other findings of significance are:

- Carriers interviewed indicated that, for the most part, they and not the generator determined the site where the waste was disposed; and

- Generators are extremely price sensitive in selecting the carrier to transport and dispose of their wastes.

S.7 CONCLUSIONS

Although this report is a preliminary investigation of transportation - related issues, there are a few conclusions that can be drawn at this time:

- The truck mode is likely to be the favoured mode of special waste transportation unless specific steps are taken to make rail more attractive;

- If wastes are to be transported long distances, prices charged by carriers will likely reflect the longer, empty backhauls;

- It is unlikely that special wastes will be transported any further than necessary for disposal, given the price sensitivity of generators. Therefore, under current legislation and practices, special wastes would only be transported from all parts of the province to a central disposal facility if closer, alternative disposal sites are not available. If total disposal costs were subsidized to make them competitive with the alternative disposal sites, a higher portion of wastes would be transported to the central disposal facility.

1.0 INTRODUCTION

1.1 PURPOSE OF THE STUDY

The research described in this report was commissioned by the Ontario Waste Management Corporation (OWMC), to provide input to the ongoing planning required before any decision on a special waste treatment and disposal site is made.

This report is illustrative in nature, in that it describes key aspects of a transportation system for special wastes, based upon a hypothetical location for a special waste treatment facility and its satellite transfer stations. The treatment facility in this report is a fully integrated facility, as opposed to being a dispersed or partially dispersed facility.

The methodology developed in this report to describe the transportation system could be applied to any site location, to any type of treatment facility (i.e. integrated or dispersed) and could also be used to compare alternative sites or types of treatment facility from the perspective of transportation.

The research results described in this report include:

- The relative risks, costs and applicability of the various transportation modes for the transportation of special wastes;
- The number of shipments, distances travelled and time required to transport special waste from generating municipal areas to the treatment facility;
- The estimated annual number of spills of special waste occurring during transportation, based upon the relevant spill probabilities;
- The existing industry currently involved in the transportation of liquid industrial waste;
- The estimated transportation costs for special waste, based upon the use of for-hire carriers; and

- o Current and proposed legislation that would affect the transportation of special wastes.

The remainder of this introductory chapter describes the definitions used in this report, the methodology used to develop the outputs of the report and the outline of the report.

1.2 DEFINITIONS

It was discovered early in the research and confirmed throughout the project that there is a great deal of confusion surrounding the definition of wastes. Throughout this report the following definitions will be used:

Special Wastes: "Wastes that cannot be adequately dealt with by the conventional methods used by existing public facilities, such as municipal sewage treatment plants, municipal incinerators, and municipal landfills"[1]

This terminology is relatively new, in that it has received widespread use only since the OWMC has come into being. Current definitions used by government and industry vary to some extent.

Currently within Ontario, certain waste movements are monitored by the Ministry of the Environment (MOE). As discussed in the subsequent section on project methodology, this monitoring process played a key role in the development of the outputs of this report. The definition of these wastes is:

Liquid Industrial Waste: As defined by Regulation 313 of the Ontario Environmental Protection Act. In essence this includes all liquid wastes that are produced as the result of industrial activity and are transported off-site for subsequent disposal.

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1. Ontario Waste Management Corporation, 1982. Facilities Development Process, Phase 1 Report.

These definitions are not synonymous, and their distinct meanings are maintained throughout this report. In Chapter 3 an attempt is made to reconcile the wastes covered by the two definitions in order that the data available with respect to the transportation of liquid industrial wastes can be used to describe the future transportation of special wastes.

1.3 PROJECT METHODOLOGY

This work was limited to the transportation system required to move special wastes. All information with respect to the types, volumes, and sources of special waste to be transported was provided by OWMC.

It is estimated that a total of approximately 1.5 million tonnes of special wastes[2] is generated within Ontario annually. Not all of this special waste will be transported to a treatment facility operated by OWMC. As a result three transportation volume scenarios, low, medium and high, of approximately 150,000, 300,000 and 500,000 tonnes, were considered for this report. These are all sub sets of the total 1.5 million tonnes.

In order to produce the project outputs, two types of activities were undertaken:

- o Data acquisition; and
- o Where required, calculations based upon the data acquired.

The chapters of the report dealing with alternative transportation modes, the existing transportation industry, and legislation are based upon data and information collected throughout the project. There was little interpretation of this data performed by the consultants; rather, the consultants have concentrated on reporting findings.

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2. Waste Quantities Study, Proctor & Redfern Ltd., August 1982

The chapters describing the number of shipments, the probability of a spill during transportation, the estimated number of spills, and transportation costs are based upon the consultants' interpretation of data collected and the subsequent use of this data in a series of calculations performed by the consultants.

1.3.1 Data Acquisition

In order to collect the data required, three approaches were used: an in-depth interview program of carriers currently transporting liquid industrial waste; interviews and conversations with the relevant federal, provincial, and municipal authorities; and a review of the relevant literature.

Throughout the conducted research, it was necessary to determine current transportation practices and relate these to the transportation needs of a facility operated by OWMC. It was not possible to gather data that directly relates to the movement of special wastes to an OWMC operated facility, primarily for the following two reasons:

- While movements of liquid industrial waste are closely monitored in Ontario, there currently exists no classification and monitoring system for solid wastes, which will be included in the special wastes handled by OWMC and

- Currently wastes in Ontario, including special wastes, are handled by a variety of geographicaly-dispersed treatment and disposal operations, including private and government facilities. Therefore, existing transportation patterns are not representative of those that would prevail if all wastes were shipped to a central OWMC facility.

The bulk of the research conducted concentrated upon the movements of liquid industrial waste in Ontario. The MOE, through the waybill system, monitors both carriers and the movements of liquid industrial waste; therefore, it was possible to identify key carriers to be interviewed for this project. The in-depth interviews of the carriers is important since it represents the first attempt to collect accident, equipment, pricing, training and general performance data directly from the carriers of liquid industrial waste.

Using the volume figures provided by MOE, carriers representing the majority of liquid industrial waste movements were identified. These carriers were then broken into two groups, one to be interviewed in person, the second to be interviewed by telephone.

The group of carriers identified to be interviewed in person consisted of 23 carriers representing 81.7 percent of the volume of liquid industrial wastes transported by MOE-licensed carriers during 1982. Of this group, 19 of the carriers, representing 74.7 percent of the total volume, agreed to cooperate fully with the study.

The second group identified consisted of 33 carriers which represented a further 13.8 percent of the total volume of liquid industrial waste transported in Ontario in 1982. Of this group, 21 of the carriers, representing 8.6 percent of the total volume, extended their cooperation.

In total, 40 carriers, representing 83.3 percent of the liquid industrial waste transported in Ontario in 1982, provided input to the study.

In order to solicit the cooperation of the carriers, letters of introduction of the consultants were sent by Dr. Chant, Chairman of the OWMC, and by Mr. Crow, Executive Director, the Ontario Liquid Waste Carriers' Association, to the selected carriers outlining the nature of the project and the need for industry input. Copies of these letters are contained in Appendix A.

Both the personal and telephone interviews were conducted using a formal questionnaire. The questionnaire was developed by the consultants, pretested with a small group of carriers, reviewed by the OWMC, then revised and mailed to the carriers in advance of the interviews. A copy of the questionnaire is contained in Appendix B.

The same approach was attempted for carriers of solid special wastes. The problem encountered was that, since MOE currently does not monitor any solid waste movements, there is no record of total volumes or significant carriers. There is a registration process for solid waste carriers, but it covers all solid wastes and is not specific enough to identify carriers of interest.

A related difficulty to the absence of a monitoring system is that shippers do not separate special solid wastes from all solid wastes, in their record keeping, at this time.

As a result of the difficulties in identifying volumes and carriers, the information on the transportation of solid special wastes is not as comprehensive as that for liquid industrial waste. This is discussed in more detail in Chapter 3.

In addition to the in-depth interviews of carriers, appropriate government agencies and officials were identified, to provide input. At the federal level, input was provided by various officials of Transport Canada, Transport Dangerous Goods Branch, and at the provincial level from officials of the Ministry of the Environment and the Ministry of Transportation and Communications. The Association of Municipalities of Ontario was also contacted to provide a variety of information.

In many cases information was also provided by private companies. These companies provided a variety of information, ranging from equipment specifications to the costs of various transportation modes.

The literature review concentrated upon providing information with respect to the relative risks of various transportation modes, relative costs of transportation modes, and most importantly upon accident studies involving trucks.

1.4 REPORT FORMAT

The report follows the structure used to determine the project outputs, as follows:

Chapter 2: Describes the relative risks and costs of the alternative modes of transportation;

Chapter 3: Describes the transportation system in terms of shipment sizes, network of highways travelled, number of shipments, distance travelled, and time required;

Chapter 4: Describes the spill risks for the transportation network and volume estimates;

Chapter 5: Describes the current liquid industrial waste transportation industry;

Chapter 6: Describes the costs of transporting the special wastes for the three volume scenarios; and

Chapter 7: Describes the relevant legislation and regulations, both current and proposed, that will affect the transportation of special wastes in Ontario.

Appendices A to G contains background documents used in preparing the report. Appendix H contains tables which show detailed calculation of numbers used in the text.

2.0 TRANSPORTATION MODE SELECTION

2.1 INTRODUCTION

The purpose of this chapter is to:

- o Identify transportation modes;
- o Discuss the factors involved in selecting a transportation mode;
- o Evaluate the alternative modes based upon these criteria; and
- o Identify the mode, or combination of modes, that is most suitable for the transportation of special waste.

2.2 TRANSPORTATION MODES

Special wastes could be transported by any of the generic transportation modes:

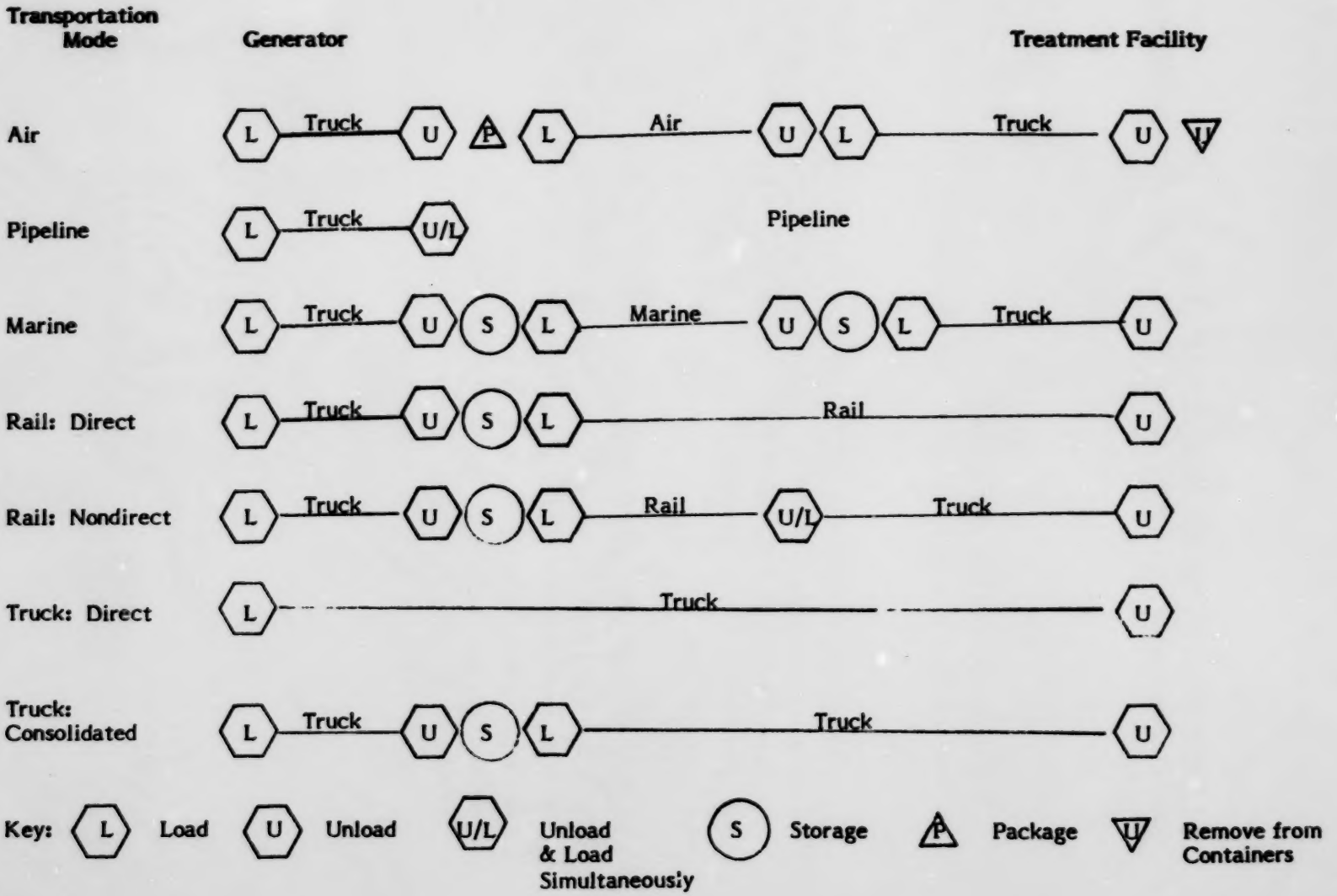
- o Air
- o Pipeline
- o Marine
- o Rail, or
- o Road;

Though, for various reasons, some of the modes may not be suitable. The discussion that follows considers the relative costs and risks of the transportation modes and other factors related to selecting a transportation mode.

Figure 2.1 is a schematic representation of how the various modes would transport special waste from the site of generation to the treatment facility.

FIGURE 2.1

COMPONENTS OF TRANSPORTATION MODES



2.3 TRANSPORTATION MODE SELECTION FACTORS

For movements of special waste the critical factors in mode selection will be:

- o Accident risk; and
- o Costs.

Both of these factors are discussed for all of the modes. Note, however, that, while one may only wish to consider these two factors, the practicality of the mode must be considered.

Another factor that must be considered is who makes the transportation mode selection. Currently the mode selection is made by the waste generator and, if a transfer is used, by the transfer station operator. Thus, under current practice OWMC would only be able to select the transportation mode from transfer stations they operate to the treatment facility.

2.4 INFRASTRUCTURE NEEDS

The economic cost of the mode includes costs other than the point-to-point movement (line-haul) costs, although this cost is likely to be the most significant. The costs of the additional infrastructure necessary to transport special wastes for the mode must be considered, as well. For the five modes the incremental infrastructure costs are:

Air:	Costs of shipping containers, and packaging and un-packaging costs;
Pipeline:	Engineering costs of designing the pipeline, capital costs of the pipeline construction, and the costs of acquiring the necessary rights-of-ways;
Marine:	Costs of port storage facilities, capital and operating costs of loading and unloading facilities;

Rail: Costs of storage facilities required to achieve efficiencies in line-haul rates and, possibly, the capital costs of required spur lines and loading and unloading facilities.

Truck: None; however it may be necessary to incur the cost of storage facilities to achieve truckload quantities.

There are some incremental costs that would be common to all modes, such as the capital costs of upgrading highways at the location of the treatment facility, as well as the ongoing maintenance costs of these roads.

The truck mode requires the least addition to the existing transportation infrastructure in order to transport special wastes to a treatment facility operated by OWMC. This reflects the fact that currently virtually all of the wastes transported in Ontario are moved by truck.

2.5 RISK OF SPILL FOR THE RESPECTIVE MODES

The risk of spills, while in-transit, for the alternative transportation modes can be compared by using a common unit of exposure. For example, in a study of spills of petroleum products, exposure was calculated in barrel-miles, and the following relative spill rates were estimated:[1]

Pipeline	- lowest spill rate
Train	- 4 times the spill rate of pipelines
Truck	- 153 times the spill rate of pipelines

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1. Mackay, D. and Wilks, A., A Statistical Analysis of Oil Spills in Canada, University of Toronto, June 1978.

Air and marine modes could not be included in the comparison because of problems with calculating comparable measures of exposure. However, both of these modes have a lower spill rate than rail and truck modes.

Since most of the special wastes can be hauled in trucks similar to petroleum tankers or rail tank cars, the spill experience for petroleum products provides a useful analog. The figures above would indicate a spill rate for truck transport of 35 to 40 times greater than rail transport. The choice of exposure units, barrel-miles, may distort the actual relative risks since a rail tank car has a capacity of 3 to 4 times as much as a tank truck, and several rail cars can be hauled in a train. However, regardless of the exposure units used in the comparison, other studies of relative risk of spill for truck and rail modes agree that the risk is considerably higher for the truck mode.[2]

In addition to the line-haul risks, the infrastructure risks of the various modes must be considered. All of the modes, with the exception of the truck mode, require various levels of extra handling of the special wastes in terms of unloading and loading to and from storage tanks. While this increases the risk of a spill, spills of this nature are normally minor in nature and occur on a site with catchment areas.

The environmental consequences of a spill are closely related to the amount that is spilled, the characteristics of the spilled material, the nature of the receiving environment and other factors. The median value of spills in the oil industry by mode are:[3]

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2. See, for example:

   Menzie, C.A.; "An Approach to Estimating Probabilities of Transportation -Related Spills of Hazardous Materials", Environmental Science & Technology, Volume 13, Number 2, February 1979; or

   Andrews, W.B., et al; "Hazardous Material Transportation Risks in the Puget Sound Region", Report No. DOT-TSC-RSPA-81-11, September 1981.

3. Mackay and Wilks (1978), based on Environment Canada data.

Pipeline:	5 to 6 tonnes
Marine:	1 tonne
Rail:	15 to 18 tonnes
Truck:	5 to 6 tonnes

Pipeline accidents have the potential to be larger than for the other modes, since the volume of the spill is not constrained by the size of the transportation equipment. For marine movements, the normal cargo capacity is 25,000 tonnes; for rail, 90 tonnes; and for trucks, 25 tonnes, which effectively limits the size of a spill.

Three modes, air, pipeline, and marine, are considered inappropriate for the transportation of special wastes, for reasons discussed below. The two remaining modes, rail and truck, are discussed in a subsequent section of the chapter.

2.6 TRANSPORTATION MODES NOT CONSIDERED SUITABLE FOR SPECIAL WASTE

Air transportation of freight is attractive only for time sensitive items, normally shipped in small quantities. The price premium that must be paid for air freight is simply not justifiable in the case of special waste movements. As well as the price penalty, there is extra handling in terms of the number of loadings and unloadings that are required for air transport. As a result of these considerations, the air transportation mode will not be considered further for the transportation of special wastes.

The major attraction of pipeline transportation is the lower risk of spills relative to the truck and train modes. Offsetting the advantage of the lower expected spill rate for pipeline transportation is the high capital cost of this transportation mode. In order for pipeline transportation to be used for all of the special wastes to be transported to the treatment facility, pipelines would have to be constructed from all of the generating sites to the treatment facility.

The capital costs of pipeline construction were estimated to be $2.2 million per kilometre in 1980.[4]

Even if the economics of pipeline transporation were more favourable, the volumes of special wastes to be moved are far too small to make the pipeline mode feasible.

Marine transportation does not appear to be feasible for the transportation of special wastes at this time. Given sufficient volume, point-to-point movements of special wastes in bulk would be cost competitive with alternative transportation modes. However, the lack of inland waterways connecting most of the municipalities that generate special wastes and potential sites for treatment facilities make the marine mode infeasible.

In summary, the three modes discussed here have been eliminated from further consideration for the transportation of special wastes -- air and pipeline modes due to economic factors, and marine due to the lack of suitable waterways.

2.7 RAIL AND TRUCK MODE

Currently the bulk of wastes, particularly liquid industrial wastes, is transported by truck within Ontario. This choice of modes, reflects the following factors:

- Geographically diverse storage, treatment, and disposal facilities;
- Private, diverse ownership of transportation and receiving facilities; and
- Relatively small shipment volumes, and the lack of on-site storage at the generator of special wastes.

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4. Mineral Aggregate Transportation Study, Peat Marwick & Partners, M.M. Dillon Limited, prepared for the Ministry of Natural Resources, December 1980.

The OWMC facility, with its attendant satellite transfer stations, is anticipated to result in a significant volume of special wastes being ultimately transported to one location. Under the volume scenarios considered for this report, approximately 150,000, 300,000, and 500,000 tonnes of special wastes will be moved to one central treatment facility. Therefore, the transportation patterns for special wastes may change once the OWMC treatment facility comes on stream.

Rail rates, for tank car movements, consist of two components - the line-haul charge and a separate charge for the tank car. The tank car is leased, normally for a minimum of one year, by the shipper, from a third party.

The cost of rail movements was determined only from the transfer stations to the treatment facility. These locations were chosen since the forecast volumes from these locations are such that volume rates can be negotiated with the railroads.

Using the forecasts of transfer station volumes, discussed later, comparative truck and rail costs were developed for transfer station movements. The ratio of rail costs to truck costs for movements from Cornwall, North Bay, and Sarnia was 1.33:1. Individual cost ratios are Cornwall 1.49:1; North Bay 1.25:1; and Sarnia 1.03:1.[5] These cost ratios include the cost of the tank cars.

Rail rates include the cost of the empty kilometres that must be travelled. As long as the empty rail kilometres are kept in balance with loaded kilometres there is no backhaul charge.

Currently the truck rates do not include a backhaul charge, either. However, it is probable that, if haul distance increases significantly, a backhaul charge will be required to cover increased operating costs.

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5. Rail costs were calculated from information provided by CP Rail, CN Rail, and North American Car Canada Ltd. Truck costs are based on Operating Costs of Trucks in Canada, 1982, Trimac Consulting Services Ltd., prepared for the Motor Carrier Branch, Surface Transport Administration, Transport Canada.

If this occurs, the competitive position of rail transport will be significantly improved.

However, rail has not been further considered in this analysis because:

- Factors other than the line-haul costs for rail must be considered as well. Foremost among these is that the cost ratios do not include any allowance for the construction of a spur line into the treatment facility;

- Rail's cost competitiveness will vary by site, since rail charges are determined to some extent by the rail traffic in the region. Therefore, rail rates, unlike truck rates, may vary on a site-by-site basis.

2.8 SUMMARY

In selecting the transportation mode for special waste, the relative cost and risks of alternate transportation modes were considered. Based upon these considerations, the truck mode was chosen as the most likely mode to transport special waste.

Air, marine, and pipeline modes were not considered suitable due to the lack of appropriate infrastructure, high unit costs of transportation, and insufficient quantities of special waste to make them cost-effective.

Rail transportation has not been considered for this report since, based on current practice, rail is more costly than truck and costing information is not complete at this time. However, if there is a desire to use rail transport, final site selection could consider factors favourable to the rail option, such as location in high rail traffic areas and proximity to main rail lines.

3.0 SPECIAL WASTE MOVEMENTS

3.1 INTRODUCTION

This chapter presents estimates of the number of shipments of special wastes that will be made annually to the OWMC facility and distances that these shipments will travel.

In addition to providing insights into arrival rates at the OWMC facility, which is useful for the planning of handling facilities, this information is required to forecast the cost of special waste transportation and to estimate the number of spills occurring during transportation.

In order to estimate the number of shipments and total distances, the following information is required:

- Volume of special wastes to be transported; by municipal area;
- The average shipment size for each type of special waste; and
- The routes from municipal areas of generation to the disposal site.

In order to illustrate how these factors are interrelated and how the number of shipments determines total distances travelled, movements have been estimated for a hypothetical special waste treatment system, consisting of an integrated disposal site and 6 transfer stations.

3.2 SPECIAL WASTE GENERATION

Independent estimates of the volumes of special wastes being generated in Ontario and the volume of special wastes that will be received at a treatment facility operated by the OWMC have not been made. The estimated number of shipments is based upon volume estimates provided by the OWMC; and no attempt has been made to account for any possible inaccuracies in the volume estimates or to estimate the portion of the wastes that will be handled by existing waste treatment and disposal facilities and those that will be handled by the OWMC facility.

The volume estimates are in the form of three different scenarios based upon: low, medium, and high volume assumptions. The estimated volumes of special waste have been broken down by the 14 categories of wastes developed in the "Waste Quantities Study".[1] The three volume scenarios are shown in Table 3.1.

TABLE 3.1

VOLUME SCENARIOS BY WASTE TYPE

Waste Category		Low	Medium	High
1.	Organic Sludge & Still Bottoms	6,000	14,100	23,500
2.	Solvents and Organic Solutions	3,000	4,900	8,200
3.	Oils and Greases	4,500	6,800	11,400
4.	Oil/Waste Mixtures	5,250	4,000	6,700
5.	Organic and Oily Residues	15,000	28,900	48,200
6.	Heavy Metal Solution and Residuals	79,500	137,300	231,300
7.	Miscellaneous Chemicals and Products	7,500	10,700	17,800
8.	Paint and Organic Residuals	9,000	16,000	26,700
9.	Aqueous Solutions and Organics	750	800	1,300
10.	Anion Complexes	2,250	7,000	9,200
11.	Inorganic Sludges & Residuals	18,495	66,700	110,800
12.	Pesticide and Herbicide Wastes	75	1,400	2,400
13.	PCB's[1]	NA	NA	NA
14.	Cleanup Residuals	NA[2]	1,400	2,300
Total		151,320	300,000	499,800

1. PCB's are not considered throughout this study.

2. There are no cleanup residuals in the low volume scenario.

Source: Ontario Waste Management Corporation.

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1. Waste Quantities Study. Proctor & Redfern Ltd., August 1982.

3.2.1 Special Wastes by Municipality

In order to develop the point to point movements required for the model, it is necessary to estimate the volume of each category of waste generated by each municipal area. This was done by maintaining the proportions of waste generated by type presented in the "Waste Quantities Studies". For each municipal area the proportion of each waste generated was calculated and then applied to the reduced totals provided in the three volume scenarios.

Total estimated special waste generation by municipal area is shown in Table 3.2. Detailed breakdowns of municipal special waste generation by waste stream are shown in Tables A.1, A.2, and A.3 in Appendix H. (All Tables with members beginning with an A are found in Appendix H.)

3.3 TRANSFER STATIONS

In developing estimates of the number of shipments and subsequent distances travelled, a hypothetical special waste treatment structure has been used for illustrative purposes. The approach used here would be appropriate for any special waste treatment system or for the comparison of alternate system configurations or sites.

The illustrative system used here consists of six (6) transfer stations and one integrated treatment facility.

The six transfer stations are located at:

- Thunder Bay
- Sault Ste. Marie
- Sudbury
- North Bay
- Sarnia
- Cornwall

The integrated treatment facility, consisting of: an incinerator, physical/chemical treatment plant, and an engineered landfill, is located at the centroid of special waste

generation for Southtern Ontario. (This is approximately 16 kilometres south of Guelph on Highway 6.)[2]

TABLE 3.2

SPECIAL WASTE GENERATION BY MUNICIPAL AREA AND VOLUME SCENARIO

Municipal Area	VOLUME SCENARIO (tonnes) Low	Medium	High
Hamilton	27,179	63,918	105,589
Toronto	30,996	55,115	92,297
Sault Ste. Marie	7,962	20,278	33,385
Mississauga	8,423	15,382	25,749
Kitchener	7,964	15,223	25,460
Windsor	6,825	12,714	21,250
Welland	6,529	13,459	22,427
Brampton	5,324	9,646	16,145
Sarnia	5,069	9,083	15,201
St. Catharines	3,979	8,075	13,473
Oshawa	4,200	8,422	14,048
Aurora	3,558	6,141	10,308
Thunder Bay	1,934	3,041	5,072
London	3,180	5,784	9,667
Barrie	1,983	4,387	7,661
Oakville	2,315	4,306	7,201
Cornwall	1,346	2,210	3,692
Guelph	1,757	3,173	5,311
Ottawa	1,721	3,198	5,329
Simcoe	1,470	3,288	5,434
Kingston	1,492	3,074	5,144
Cochrane	817	1,223	2,037
Woodstock	1,483	2,687	4,501
Chatham	1,379	2,598	4,338
Kirkland Lake	977	2,010	3,342

2. Identification of Centres of Gravitation of Special Waste Generation in Ontario, Proctor & Redfern Ltd., December 1982.

TABLE 3.2 (continued)

Municipal Area	VOLUME SCENARIO (tonnes) Low	Medium	High
Brantford	1,114	1,900	3,185
Brockville	881	1,825	2,562
Belleville	780	1,396	2,336
St. Thomas	737	1,368	2,289
Cobourg	846	1,155	1,931
Halton Hills	548	911	1,624
Stratford	521	978	1,637
North Bay	450	819	1,374
Peterborough	487	850	1,419
Sudbury	305	586	973
Grimsby	410	684	1,148
Hawkesbury	257	510	847
Huntsville	150	320	532
Lindsay	139	318	531
Owen Sound	241	418	702
Dunnville	141	290	470
Orangeville	174	289	485
Walkerton	86	141	238
Other - Northwest	776	1,202	2,005
Other - Southeast	922	2,491	4,135
Other - South Central	358	637	1,060
Other - Southwest	240	399	671
Other - Northeast and Central	153	255	425

Numbers have been rounded.

Municipal areas include all of the communities outlined in Appendix G of the Waste Quantities Study.

3.4 FORECASTING TRANSPORTATION PRACTICES

The introduction of a waste treatment and disposal site operated by OWMC will obviously have an impact upon the existing transportation network for waste within Ontario. There are two major possible impacts that such a facility may have:

- o Change the nature of the transportation network in terms of routing considerations, types of equipment used, shipment size, etc; and/or

- o Increase the volume of wastes being transported, as those special wastes for which an acceptable method of treatment currently does not exist are removed from storage and enter the transportation system.

As a result, the current transportation patterns may be altered after the OWMC facility begins operations. However, the physical nature of the wastes being transported will not be in any significant way altered, in that they will still be in a liquid, solid, or sludge state.

As a result, even though there may be changes in the transportation network, the current transportation of wastes in Ontario provides significant insights into the transportation network that would be used to move special wastes to the OWMC facility.

Transportation practices described in this section have been developed based both upon existing transportation practices and new practices that are likely to develop. The average shipment sizes that are used are based upon current industry procedures, while the transportation routes used are based upon the hypothetical location of the treatment facility.

3.5 SHIPMENT SIZE

The calculation of the average shipment size by waste classification is one of the key components to the development of the transportation model. Average shipment size, divided into special waste volumes generated by municipal areas, provides a sound estimate of the number of shipments from each municipal area.

The calculation of average shipment sizes has been determined in a different manner for liquid and solid special wastes; and, as a result, the following discussion treats the two separately.

3.5.1 Liquid Industrial Wastes

Liquid industrial wastes have been defined earlier, using the Ministry of the Environment's (MOE) definition. These wastes also share certain physical properties, in that they are either in liquid or sludge form. This is significant, for the physical state is a major determinant of the type of transportation equipment used. Both liquid and sludge waste material are transported in bulk, primarily in tank trucks.

In Waste Quantities Study, it is estimated that liquid and sludge special wastes represent approximately 74 percent of the special wastes generated in the province, 1.1 million tonnes out of a total of 1.49 million tonnes.

The waybill system operated by MOE captures a significant amount of information pertaining to current movements of liquid industrial wastes within Ontario. The information is not directly comparable to the waste categories used in the Waste Quantities Study, for the following reasons:

- The waste classifications are different; the Waste Quantities Study uses the University of California at Davis (UCD) waste classifications, while MOE uses a system of 21 broad waste categories that has been developed based on experience, and

- The MOE system of classification may not capture all of the liquid and sludges that are part of the UCD waste classification system being used by OWMC.

In order to use the waybill data, it has to be related to the UCD waste categories. In the work performed by Proctor & Redfern for the OWMC, this relationship was established, and the same format is used here.

In Table A.4, the individual UCD components of each of the 14 waste classifications, the corresponding MOE waybill classification, and the estimated volume of each UCD category are shown. The physical state of the waste stream is also shown in the table.

From waybill data provided by MOE, average shipment sizes by MOE waste classification were calculated based upon a sample of carriers. For each waste classification, a truckload and a less-than-truckload average shipment size were calculated. At the same time the proportion of each waste stream moving in truckload and less-than-truckload size shipments was calculated. These figures were then used to calculate weighted average truckload and less-than-truckload shipment size respectively for each of the 14 waste categories, as shown in Table 3.3.

A truckload shipment size normally represents the point at which the tank trailer is physically full (cubed out) or where the legal weight limit is reached (the load has grossed out.) However, due to the range of equipment and the different specific gravities of the material being transported by the carriers, not all of the 'truckload' shipment sizes are the same and, as a result, an average truckload size has been calculated. In order to be considered as a truckload shipment, a load had to be 20,000 litres or greater (approximately 4,400 gallons). While this does not represent the maximum size trailer being used for waste movements (in the survey data, carriers have indicated that they operate some 41,000 litre (9,000 gallon) tank trailers), it would be close to the maximum weight limit for the majority of vehicles.

The majority of tractor/trailer combinations being used to move liquid industrial waste would have a gross vehicle weight (GVW) of 47,000 kg (104,000 lb) (i.e. the weight of the tractor, trailer, and payload should not exceed this amount.) In the case of a 20,000-litre movement, the estimated weight would be:

Tractor	6,800	kg
Trailer	9,000	kg
Payload	20,000	kg
Total	35,800	

For a 25,000 litre movement, the total GVW would be 40,800 kilograms. Since the current use of transfer stations is reflected in the calculation of average shipment size, and the split between 'truckload' and less-than-truckload shipments, these shipment sizes will reflect current industry practices with respect to load consolidation.

TABLE 3.3

CALCULATED 'TRUCKLOAD' (TL) AND LESS THAN TRUCKLOAD (LTL) SHIPMENT SIZES, FOR LIQUID SPECIAL WASTES

	OWMC WASTE CLASS	MOE Components	Weighted TL%	Weighted LTL%	Average TL Size (litres)	Average LTL Size (litres)
1)	Organic Sludge & Still Bottoms	82.6% 290 5.8% 205 3.9% 208 7.5% NA	15	85	23,700	8,600
2)	Solvents & Organic Solutions	13.6% 204 54.8% 203 2.7% 290 28.8% 206/207	44	56	26,100	7,300
3)	Oils & Greases	100% 202	20	80	22,600	7,600
4)	Oil Water Mixtures	100% 201	48	52	24,000	9,700
5)	Organic & Oily Residue	99.4% 201 .6% 205	48	52	23,900	9,700
6)	Heavy Metal Solutions & Residuals	66.7% 107 3.5% 102 11.5% 103 7.2% 190 10.3% 402	43	57	23,800	12,400
7)	Miscellaneous Chemicals	Solids Primarily				
8)	Paint & Organic Residuals	78.5% 301 1.8% 202 19.7% 205	17	83	23,900	7,300
9)	Aqueous Solutions with Organics	97.7% 290 2.3% 190	15	85	25,900	9,300
10)	Anion Complexes	92.5% 104 7.5% 190	3	97	23,900	9,100
11)	Sludges & Inorganic Residuals (22% Liquid; 78% Solid)	100% 402	47	53	25,800	10,700
12)	Herbicides & Pesticide Waste (25 Liquid; 75% Solid)	100% 302	0	100	NA (25) for TL	8,700
14)[1]	Cleanup Residuals (56% Liquid; 44% Solid)	100% 402	47	53	25,800	10,700

1. Special waste class 13, PCB's, is not included

These average shipment sizes are for the current experience of the liquid industrial waste transportation industry. As a result, these figures reflect the current industry practice with respect to consolidation of shipments at MOE certified transfer stations.

There are currently 18 MOE certified transfer stations operating within Ontario. During 1982 these transfer stations handled an estimated 32,000 tonnes of liquid industrial waste. The purpose of the transfer stations is to provide interim storage for relatively small shipments of waste, before transporting the waste to the final disposal site. By storing the wastes until truckload volumes are reached, the per litre transportation cost can be reduced. The amount of this saving will increase in direct proportion with the distance to the disposal facility being used.

3.5.2 Solid Special Wastes

Solid special wastes are estimated to represent approximately 369,100 tonnes, or 25 percent of the special wastes generated annually within Ontario.[3]

As was shown in Table 3.3, the solid special wastes are concentrated in three OWMC waste categories:

- Class 7, Miscellaneous Chemicals, 100 percent solid;
- Class 11, Sludges and Inorganic Residuals, 78 percent solid; and
- Class 14, Cleanup Residuals, 44 percent solid.

In terms of the volume scenarios being considered for this report, the volumes of solid special wastes estimated to be transported to the treatment facility are shown in Table 3.4.

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3. Ontario Waste Quantities Study. Proctor & Redfern Ltd., August 1982.

TABLE 3.4

ESTIMATED VOLUME OF SOLID SPECIAL WASTES TO BE TRANSPORTED

	Low Volume (tonnes)	Medium Volume (tonnes)	High Volume (tonnes)
Class 7	7,500	10,700	17,800
Class 11	14,400	52,000	86,400
Class 14	-	600	1,000
Total	21,900	63,300	105,200
Percent of Total Special Wastes Transported	14.5%	21.1%	21%

Unlike liquid industrial waste, there is no monitoring program equivalent to the MOE waybill system for solid special wastes at this time. (Proposed regulations, discussed in Chapter 7 of the report, will require that the transportation and disposal of solid special wastes be recorded on waybills in the same manner as liquids.) As a result, it was not possible to calculate average shipment sizes for solid wastes from the record of historical movements, and alternative approaches were pursued.

The first approach involved identifying carriers that would likely be involved in transporting solid special wastes. Contact was established with the Ontario Waste Management Association, whose members transport and dispose of solid wastes. The Association provided lists of key carriers and disposal site operators.

Contacts with key carriers of solid wastes established that:

- The carriers were not involved in the transportation of solid wastes that they viewed as 'special'. Other than asbestos, where the material was double bagged for transportation and immediately buried upon receipt at the landfill site, no special precautions were taken. (Solid loose wastes are typically transported in an enclosed vehicle. Therefore, covering a dump truck load with a tarp would not be considered as a special precaution); and

- o It is possible that the carriers are transporting 'special' wastes, either separately or mixed with other wastes, and are not aware of it, due to the lack of reporting requirements.

Contact was also established with a solid waste disposal site, certified for operation by the MOE. The operation landfilled nonhazardous solid wastes including foundry sand which is not considered to be 'special' by the site operator. The operator of the site was not involved in the transportation of the solid wastes, relying instead on the generator of the waste to provide transportation to the site. Transportation of solid special wastes to that particular site was normally contracted by the generator to a carrier using either a tandem dump truck or, more usually, a tractor/trailer dump combination.

A third avenue explored in attempting to establish shipment sizes for solid wastes involved contacting the waste generator. This was done only for two solid waste types -- foundry sand and baghouse waste -- since the major generators of these wastes could be readily identified as the steel industry.

Contact with members of the industry confirmed that, when these wastes were transported, they moved in dump trucks in load sizes of between 25 and 30 tonnes. However, in one instance the waste was not transported as it was either recycled or landfilled on site.

For other solid waste streams identified as being special, it was not possible to identify either carriers, disposal sites, or generators that accounted for any significant portion of the estimated volume. This reflects the wide range of solid wastes included in the estimate and the corresponding large number of generators.

In summary, it was established that:

- o Foundry sands and baghouse wastes would move in loads of 25-30 tonnes, when transported. These two waste streams represent 50 percent of the total special solid wastes estimated to be generated annually; and

- The remainder of the estimated volume of special solid wastes, due to the diverse nature of the wastes and method of generation, are likely transported in shipment sizes ranging from 1 kilogram to 30 tonnes.

Inorganic solids, such a foundry sands and baghouse wastes, together account for 98 percent of the solid special wastes included in OWMC Class 11. Class 11 wastes account for 66 percent, 82 percent, and 82 percent respectively of the special solid wastes in the low, medium, and high volume transportation scenarios. As a result, the average shipment size for these wastes account for a significant portion of the movement of solid special wastes being considered.

In the following discussion of estimated number of shipments, an average shipment size of 27.5 tonnes has been used for Class 11. No estimate of the number of shipments for Class 7 and the solid component of Class 14 has been made due to the lack of data. In order to provide reasonable estimates of average shipment size for these two waste classes, it would be necessary to conduct a survey of waste generators, which is beyond the scope of the present study.

3.6 ESTIMATED NUMBER OF SHIPMENTS BY WASTE TYPE AND MUNICIPAL AREA

By combining the estimated waste generation by waste stream and municipal area discussed in Section 3.2.1 with the average shipment sizes discussed in Section 3.5, the estimated number of shipments by municipal area and waste stream can be calculated.

In developing the estimated number of shipments, a number of assumptions have been used. These are:

- The geographic distribution of wastes shipped to the treatment facility is the same as the geographic distribution of waste generation.

- The ratio of 'truckload' to less-than-truckload shipments has been maintained for all municipalities within approximately 1.5 hours travel time to the treatment facility;

- Movements from the transfer stations are all 'truckload' movements based upon the average truckload size of the waste class. This assumes that current industry practice is maintained, and that these movements are made in a tractor/trailer combination;

- Transfer stations serve both the municipal area they are located in and municipal areas in their proximity, where it makes sense for loads to be consolidated at these points;

- Carriers serving municipal areas located more that 1.5 hours travel time from the treatment facility or a consolidation point will likely consolidate less-than-truckload shipments, even in the absence of an OWMC consolidation station, due to the transportation economics. Therefore, only 'truckload' shipments will be made from these municipal areas to the treatment facility. The 1.5 hours travel time reflects the interrelationships of loading time, unloading time, travel time, carry capacity, and storage requirements in determining the most cost-efficient shipment size; and

- For the City of Toronto, a north and south origin have been used for the source of special waste generation, with 50 percent of the total volume originating from each point.

Based upon these assumptions, the estimated number of special waste shipments from the municipal areas to the treatment facility was developed, as shown in Table 3.5. As well, shipments to and from the transfer stations were calculated, as shown in Tables 3.6 and 3.7. Detailed estimates of special wastes by individual waste class and municipal area can be found in Tables A.5, A.6, and A.7.

These shipment estimates do not include three types of shipments. In the allocation of special wastes to municipal areas process, some special wastes were assigned to regional areas. These special wastes represent approximately 1 percent of the transportation volume scenarios. No estimate of the number of shipments for these areas has been made.

TABLE 3.5

ESTIMATED NUMBER OF
SHIPMENTS OF SPECIAL WASTES
TO THE TREATMENT FACILITY

	LOW VOLUME	MEDIUM VOLUME		HIGH VOLUME		
Municipal Area		Liquids	Solids	Liquids	Solids	Liquids	Solids
Hamilton		1,387	233	2,816	840	4,565	1,395
Toronto N		1,077	13	1,934	46	3,212	77
Toronto S		1,077	13	1,934	46	3,212	77
Sault Ste. Marie		190	91	387	329	646	547
Mississauga		618	5	1,086	19	1,806	31
Kitchener		542	15	976	53	1,624	88
Windsor		281	4	524	15	870	25
Welland		375	31	693	112	1,142	185
Brampton		371	5	658	17	1,086	28
Sarnia		212	3	371	11	613	19
St. Catharines		222	18	407	66	676	110
Oshawa		335	8	658	28	1,088	47
Aurora		249	2	422	5	722	9
Thunder Bay		32	1	52	4	84	6
London		223	6	386	21	637	35
Barrie		61	18	115	64	192	107
Oakville		190	1	353	4	587	6
Cornwall		51	1	67	2	109	3
Guelph		118	3	206	9	340	16
Ottawa		26	3	48	11	80	19
Simcoe		81	10	160	36	256	60
Kingston		53	8	95	28	160	47
Cochrane		--	--	--	--	--	--
Woodstock		112	2	190	8	318	13
Chatham		20	2	35	8	56	13
Kirkland Lake		--	4	--	16	--	26
Brantford		88	1	147	2	248	3
Brockville		38	1	59	4	100	6
Belleville		35	1	57	2	93	3
St. Thomas		30	1	52	2	93	3

TABLE 3.5 (continued)

Municipal Area	LOW VOLUME	MEDIUM VOLUME		HIGH VOLUME		
		Liquids	Solids	Liquids	Solids	Liquids	Solids
Cobourg		24	1	42	4	71	6
Halton Hills		44	1	70	2	117	3
Stratford		37	2	70	6	115	9
North Bay		20	--	33	--	55	--
Peterborough		21	1	33	2	55	3
Sudbury		14	1	19	4	31	6
Grimsby		30	--	47	--	76	--
Hawkesbury		--	1	--	4	--	6
Huntsville		6	1	9	4	14	6
Lindsay		9	1	9	4	15	6
Owen Sound		12	--	17	--	29	--
Dunnville		11	1	17	2	27	3
Orangeville		17	--	24	--	38	--
Walkerton		5	--	7	--	11	--

TABLE 3.6

NUMBER OF SHIPMENTS TO TRANSFER STATIONS

Transfer Station	VOLUME SCENARIO		
	Low	Medium	High
Cornwall	102	203	317
North Bay	53	78	126
Sarnia	78	152	252

TABLE 3.7

NUMBER OF SHIPMENTS FROM TRANSFER STATIONS TO TREATMENT FACILITY

Transfer Station	VOLUME SCENARIO		
	Low	Medium	High
Cornwall	74	85	140
North Bay	42	76	126
Sarnia	33	61	101

Secondly, as was discussed in the previous section, it was not possible to estimate average shipment sizes for all of the solid special wastes, with the result that an estimate of the number of shipments was not made. These special wastes represent between 4 and 5 percent of the transportation volume scenario.

Finally no estimate is included for the number of shipments occurring within municipal areas where local consolidation is taking place. In terms of time and distances involved, which are the significant factors from a cost and accident probability perspective, these movements are not estimated to be significant.

3.7 THE TRANSPORTATION NETWORK

The primary objective when constructing the transportation network is to join the municipal areas listed in Section 3.2 (the sources of the special wastes) to the destinations while minimizing total haulage distance, travel time, and the probability of a spill. The destination, in most cases, will be the treatment facility which is assumed, for the purpose of constructing the transportation network, to be located at the centroid of waste generation for southern Ontario. In the remaining cases, the destination will be regional transfer stations, all of which are also municipalities that are sources of special wastes in their own right.

The features of the transportation network are summarized in Table 3.8:

TABLE 3.8

FEATURES OF THE TRANSPORTATION NETWORK

Sources:	- 44 municipal areas that generate special wastes
Destination:	- 6 OWMC transfer stations - the treatment facility

For the purpose of constructing the network, it is assumed that the sources and destinations are fixed. Therefore, the only variable element of the model that can be used to achieve the objectives of minimizing total haulage distance, travel time, and the risk of a spill is the choice of the road links to join the sources to the destinations.

In the present case, the decision rule for choosing the links is simple. Using the highest class of highway available will minimize total haulage distance and travel time. As can be seen from Table 3.9, the probability of an accident is also reduced if the highest class of highway is used.

TABLE 3.9

ACCIDENT RATES ON ONTARIO ROADS - 1981

Highway Type	Accident Rate*
Freeways	0.8
King's Highway	1.2
Secondary Highways	1.6
Other Roads	4.3
Provincial total	2.8

* Accidents per million vehicle kilometres of travel

Source: "Traffic Volumes: King's Highway and Secondary Highways", 1981, Ministry of Transportation and Communications.

The accident rate for the King's Highway shown above includes the rate shown for freeways. The King's Highway consists of the Queen Elizabeth Way (Highway 1), Highway 2 to 169, and the 400 series -- Highway 400 to 427. Secondary highways include Highway 500 to 809. Other roads are urban streets and other roads not under the jurisdiction of the Ministry of Transportation and Communications.

Since all of the sources of special wastes are near major municipalities, they are well served by major highways, and virtually the entire transportation network can be constructed from freeways and other highways of the King's Highway. The network, using freeways wherever possible and other highways otherwise, is shown graphically in Figure 3.1.

The beginning, end, distance, estimated travel time, and the accident rate in accidents per million kilometres of vehicle travel for each link of the transportation network are shown in Table A.8. The travel times are based upon average speeds of 90 km/hr on freeways, 70 km/hr on other highways, and 50 km/hr on other roads.

The transportation network does not include travel within municipalities for two reasons:

- Sufficient information on the location of plants that generate special wastes and quantities was not available;
- The distance travelled (exposure to risk) in municipalities is small in comparison to total distance travelled. (Industrial and commercial facilities tend to be located near major highways.)

The appropriate links of the network can be joined together into routes that connect the desired sources and destinations. The routes of the transportation network, along with distance, estimated travel time, and the accident rate for each are shown in Table 3.10.

Accidents that occur on freeway ramps are not included in the accident rates shown in Table A.8 since ramp accidents are not assigned to specific road segments by the Ministry of Transportation and Communications. However, at the authors' request, a special computer run was made of the MTC accident data base; and it was found that in 1981, of the 12,410 freeway accidents, 17 percent occurred on ramps. In 1980, of the 12,425 freeway accidents, 14 percent occurred on ramps. In order to account for the probability of accidents on freeway ramps, the accident rate, for the portion of the routes shown in Table 3.10 that are over freeways, has been increased by 15 percent. Thus, the accident rates shown in Table 3.10 are the weighted (by distance) averages of 1.15 times the accident rates for freeway links and 1.0 times the accident rates of the links comprised of other roads.

With the routes of the transportation network defined by the characteristics shown in Table 3.10, all that is required to estimate the variables of the objective function -- total haulage distance, travel time, and probability of a spill -- are the numbers of trips that are made on each route during a given period of time and an estimate of the portion (conditional probability) of the number of motor vehicle accidents that result in a spill.

Figure 3.1 THE TRANSPORTATION NETWORK

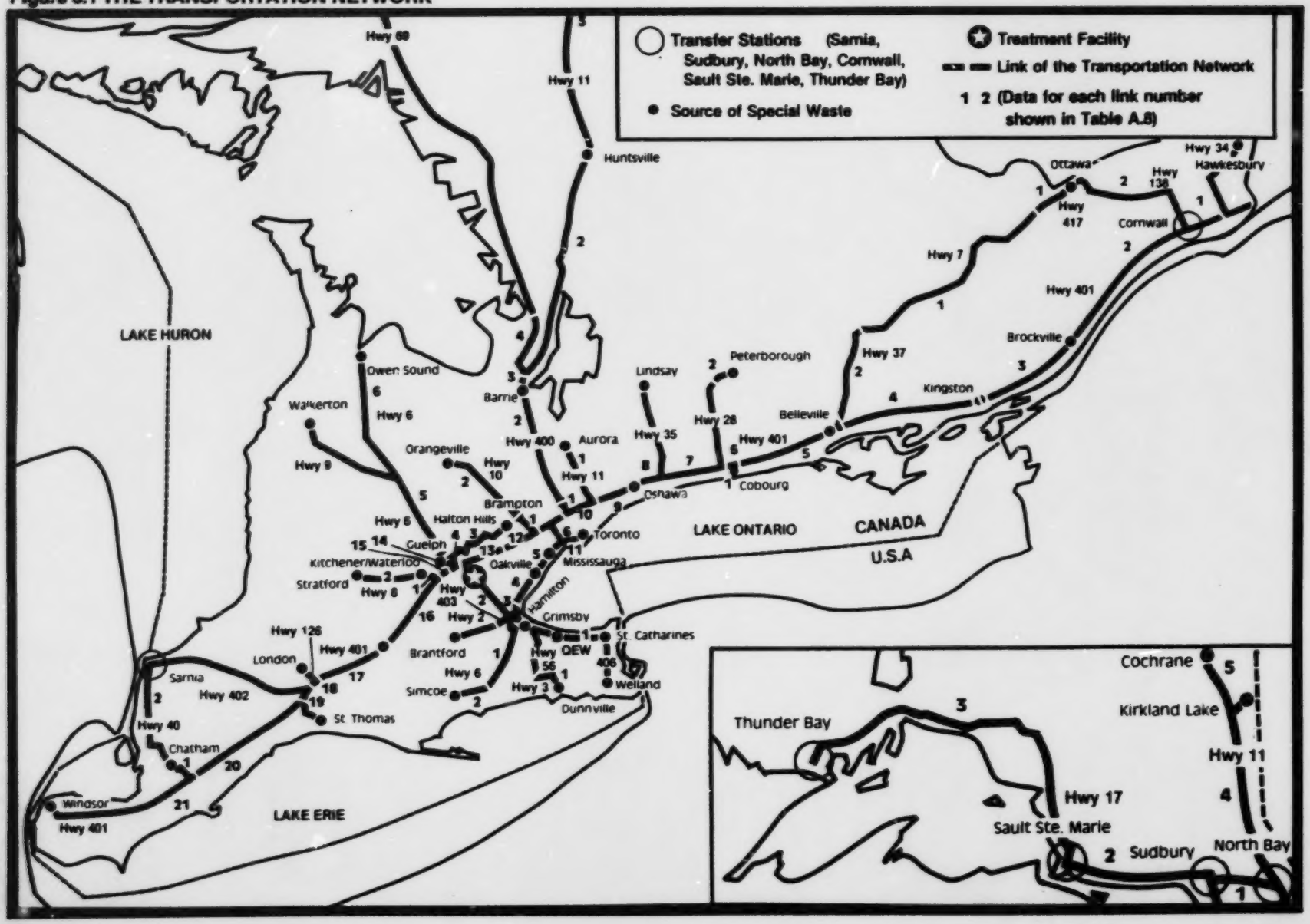

TABLE 3.10

ROUTES OF THE TRANSPORTATION NETWORK

Source/ Destination	Links of the Route	Distance (km)	Time (min)	Accident Rate*
Hamilton Treatment F.	QEW-3, 403-1, 6-2	40.8	29	1.0
Toronto North Treatment F.	400-1, 401-11 to 13, 6-3	69.1	46	1.0
Toronto South Treatment F.	QEW-4 to 6, 403-1, 6-2	87.8	76	.9
Sault Ste. Marie Treatment F.	17-2, 69-1, 400-1 to 4, 401-11 to 13, 6-3	743.1	605	.8
Mississauga Treatment F.	QEW-4 and 5, 403-1, 6-2	61.7	45	.9
Kitchener Treatment F.	8-1, 401-14 and 15, 6-3	33.4	29	.6
Windsor Treatment F.	401-14 to 21, 6-3	293.5	198	.4
Windsor Sarnia	401-21, 40-1 and 2	169.4	131	1.1
Welland Treatment F.	406-1, QEW 1 to 3, 403-1, 6-2	113.3	92	1.2
Brampton Treatment F.	10-1, 401-12 and 13, 6-3	58.9	48	.8
Sarnia Treatment F.	402-1, 401-14 to 18, 6-3	223.4	152	.9
St. Catharines Treatment F.	QEW-1 to 3, 403-1, 6-2	84.6	58	.8
Oshawa Treatment F.	401-9 to 13, 6-3	122.6	85	1.0

* Truck accidents per million km of travel

TABLE 3.10 (continued)

ROUTES OF THE TRANSPORTATION NETWORK

Source/ Destination	Links of the Route	Distance (km)	Time (min)	Accident Rate*
Aurora Treatment F.	11-1, 401-10 to 13,	103.9	78	1.3
Thunder Bay Treatment F.	17-2 and 3, 69-1, 400-1 to 4, 401-11 to 13, 6-3	1,447.5	1,208	1.5
London Treatment F.	126-1, 401-14 to 17, 6-3	124.8	91	.5
Barrie Treatment F.	400-1 and 2, 401-11 to 13, 6-3	140.7	99	.8
Oakville Treatment F.	QEW-4, 403-1, 6-2	44.6	34	.9
Cornwall Treatment F.	138-1, 401-2 to 13, 6-3	482.6	338	.7
Guelph Treatment F.	6-3 and 4, 401-14	20.3	18	.9
Ottawa Treatment F.	417-2, 7-1, 37-2, 401-5 to 13, 6-3	484.9	361	.8
Ottawa/Cornwall	417-1, 138-2	92.7	68	.6
Simcoe Treatment F.	3-2, 6-1 and 2	93.0	77	.8
Kingston Treatment F.	M-1, 401-4 to 13, 6-3	328.6	224	.7
Cochrane/North Bay	11-4 and 5	375.9	322	1.6
Woodstock Treatment F.	2-1, 401-14 to 16, 6-3	73.2	53	.7

* Truck accidents per million km of travel

TABLE 3.10 (continued)

ROUTES OF THE TRANSPORTATION NETWORK

Source/ Destination	Links of the Route	Distance (km)	Time (min)	Accident Rate*
Chatham Treatment F.	40-1, 401-14 to 20, 6-3	232.2	160	.5
Chatham/Sarnia	40-2	77.7	67	1.7
Kirkland Lake/ North Bay	11-4	238.2	204	1.8
Brantford Treatment F.	53-1, 403-2, 6-2	57.3	46	1.3
Brockville Treatment F.	401-3 to 13, 6-3	403	279	.7
Brockville/ Cornwall	401-2	92.8	62	.7
Belleville Treatment F.	37-1, 401-5 to 13, 6-3	254.7	175	.7
St. Thomas Treatment F.	4-1, 401-14 to 19, 6-3	143.3	98	.6
Cobourg Treatment F.	45-1, 401-6 to 13, 6-3	184.5	128	.8
Halton Hills Treatment F.	7-3, 6-3 and 4, 401-14	64.6	56	1.7
Stratford Treatment F.	8-1 and 2, 401-14 and 15 6-3	80.1	69	.7
North Bay Treatment F.	11-2 and 3, 400-1 to 3, 401-11 to 13, 6-3	393.7	314	1.0
Peterborough Treatment F.	7-2, 28-1, 401-7 to 13, 6-3	217.1	161	1.0
Sudbury Treatment F.	69-1, 400-1 to 4, 401-11 to 13, 6-3	436.3	347	1.3

* Truck accidents per million km of travel

TABLE 3.10 (continued)

ROUTES OF THE TRANSPORTATION NETWORK

Source/ Destination	Links of the Route	Distance (km)	Time (min)	Accident Rate*
Grimsby Treatment F.	QEW-2 and 3, 403-1, 6-2	57.5	40	.9
Hawkesbury/ Cornwall	34-1, 401-1, 138-1	88.1	72	1.3
Huntsville Treatment F.	11-2, 400-1 to 3, 401-11 to 13, 6-3	271.7	209	.8
Lindsay Treatment F.	35-1, 401-8 to 13, 6-3	198.0	146	1.1
Owen Sound Treatment F.	6-3 to 6, 401-14	159.5	137	.7
Dunnville Treatment F.	3-1, 56-1, QEW-3, 403-1, 6-2	77.4	68	1.5
Orangeville Treatment F.	10-1 and 2, 401-12 and 13, 6-3	94.7	79	.9
Walkerton Treatment F.	9-1, 6-3 to 5, 401-14	128.4	110	.9

* Truck accidents per million km of travel

The transportation network as described above will result in the minimum: haulage distance, travel time, and probability of spill for a given quantity of special wastes. It can, therefore, be considered as the "base case" against which to compare alternative sites for the treatment facility.

3.8 TRAVEL DISTANCES AND TRAVEL TIME

By combining the estimates of the number of shipments from each municipality and the distances travelled from the transportation network, the total distances travelled were calculated. These distances, along with travel time estimates, are shown in Table 3.11. Detailed estimates of time and distance are shown in Tables A.9 - A.13.

In addition to the on-highway travel time, estimates of the amount of travel time within the municipalities, representing the time to travel to the site of the generator and from the generator's site to the highway network, must be included to arrive at the total travel time. For Hamilton, Toronto, and Mississauga this in-town travel has been estimated at 30 minutes per trip, and for all other municipalities it has been estimated at 15 minutes per trip.

Yearly arrival rates at the treatment facility are shown in Table 3.12, with more detailed data shown in Table A.14.

TABLE 3.11

TOTAL DISTANCES TRAVELLED LOADED BY VOLUME SCENARIO

	(KILOMETRES)		
	Low	**Medium**	**High**
Liquids	1,018,000	1,851,000	2,951,000
Solids	105,000	379,000	627,000
Total	1,123,000	2,230,000	3,578,000

TOTAL TIME FOR LOADED TRAVEL BY VOLUME SCENARIO

	(HOURS)		
	Low	**Medium**	**High**
Liquids	16,028.8	29,258.7	49,116.5
Solids	1,572.1	5,671.9	9,342.3
Total	17,600.9	34,930.6	58,458.8

TABLE 3.12

SUMMARY OF SHIPMENTS RECEIVED AT TREATMENT FACILITY

	Liquid Shipments	Solid Shipments	Total Shipments
Low Volume	8,502	514	9,016
Medium Volume	15,507	1,840	17,347
High Volume	25,636	3,052	28,688

4.0 THE PROBABILITY OF A SPILL DURING TRANSPORTATION

The statistical theory of spill probabilities is relatively straightforward. However, the theory alone is not very useful for predicting spill patterns and frequencies. To go from the theory to estimates of the expected, average annual spill frequencies requires a considerable amount of empirical data.

The statistical theory is presented at the beginning of the chapter and provides a basis for the discussion that follows. Existing data that have been published are examined for their usefulness in determining expected spill frequencies for Ontario. The shortcomings of this approach are pointed out, and an attempt to overcome them by collecting the required data during the survey has been made. The relevant survey results are presented and are used to calculate expected annual, average spill frequencies. These frequencies are presented and discussed at the end of the chapter.

Spills can occur at any of the three stages of the transportation process: during loading, while in transit, and during unloading. In-transit spills can be further divided into those that result from a motor vehicle accident and those that are caused by an equipment failure or other event that is not accident related.

In order to estimate the probability of a transportation related spill, it is assumed that spills occur randomly and independently of the amount of time or exposure between spills; i.e. the distance travelled until the next spill is independent of the distance travelled between previous spills.

If the additional assumption is made that a small number of spills will occur, i.e. there is a fair probability that there will be zero spills in a given time period, the number of spills, n will be Poisson distributed with the probability density function:

$$P_\lambda(n \mid t) = \frac{e^{-\lambda t}\,(\lambda t)^n}{n!} \qquad n = 0, 1, 2, 3, \ldots$$

The probability of n spills is proportional to the amount of exposure t. The Poisson distribution has one parameter, which has the physical interpretation of being the true, unknown spill rate. It can be estimated from empirical data as:

$$\hat{\lambda} = \nu/\tau$$

ν = number of spills
τ = exposure period.

Since four distinct types of transportation - related spills are possible, four separate estimates of spill rates are required. The spill rates can be expressed as follows:

- spills while loading: λ_l = spills per 10,000 loadings,
- spills that result from a motor vehicle accident: λ_m = (accidents per 1,000,000 km of travel) x (probability of spill, given that an accident has occurred),
- spills that result from an equipment failure while in transit: λ_f = spills per 1,000,000 km of travel.
- spills while unloading λ_u = spills per 10,000 unloadings.

The Poisson distribution is useful for calculating the probability of a specific number of each type of spill occurring, but if we wish only to calculate the expected number of spills for a period of, say one year, all we require are estimates of the λ's and the amount of exposure. The expected number of spills is:

$E(\nu)$ = λ_l x number of loadings per year +
λ_m x vehicle kilometres travelled per year +
λ_f x vehicle kilometres travelled per year +
λ_u x number of unloadings per year

As discussed above, spill probabilities are Poisson distributed and, therefore, the number of spills that occur each year will likely show significant year-to-year variations. Therefore, the expression for $E(\nu)$, the expected number of spills, is equivalent to the average for a large number of years.

Having made that qualification, $E(\nu)$ is the measure that is most useful to assess the risk of spills associated with alternative transportation networks. Only the baseline transpor tation network described in the previous chapter will be considered here, but $E(\nu)$ for any number of transportation networks could be made and the results compared. Exposure -- loadings, vehicle kilometres travelled, unloadings -- is relatively easy to estimate and is contained in the previous chapter for the baseline transportation network. The real challenge is to arrive at reliable estimates for the spill rates.

4.1 ESTIMATING SPILL RATES FROM PREVIOUS STUDIES

Until recently, very little reliable empirical data have been available from which to estimate the spill rates, λ's. Consequently, studies of the probability of spills of special wastes have typically been based on theoretical approaches, such as fault-tree analysis,[1] or have used the probability of a motor vehicle accident (regardless of whether or not a spill occurred) as the only measure of transportation risk.[2] While these approaches are useful for a comparative analysis of the transportation risk associated with optional sites for treatment facilities, they are less useful for estimating the expected number of spills, $E(\nu)$.

Several data bases that contain details of reported spills of all types of hazardous materials exist. The Ontario Ministry of the Environment, Transport Canada, Environment Canada, and their United States counterparts, amongst others, maintain such data bases. The main shortcoming of all of them is that they are neither complete nor representative of the actual spill experience. As a result, great care must be taken if they are used as the basis for estimating the spill rates, λ's.

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1. An example of this approach is:

   F.G. Bercha and Associates Limited, "Risks Associated with the Transportation to Treatment of Hazardous Waste Substances", December 1980.

2. See, for example:

   MacLaren Engineers Planners and Scientists Inc., "The Siting of Facilities and The Management of Liquid Industrial and Hazardous Wastes in Ontario", Report to the Ministry of the Environment, November 1980.

There is a virtual complete lack of reliable data on the frequency of loading and unloading spills. There are two main reasons why this is an area of relatively little interest. Firstly, loading and unloading spills occur in controlled environments or, at least, in environments that could and should be controlled. For example, the area where a truck is loaded or unloaded should be impermeable and surrounded with a berm that is high enough to contain the entire contents of the storage and vehicle tank, in the event of a spill. Firefighting and other safety equipment should be readily available. Such spills are usually not severe in terms of injuries or property damage; they are generally not reported in the press and they rarely become public issues.

The second reason is that the numbers of loadings and unloadings are primarily a function of waste quantities, and they change little as the location of the treatment facility changes. Therefore, the number of loading/unloading spills can be considered a constant for the purpose of carrying out a comparative analysis of the transportation risk associated with alternative treatment facility sites.

There is a similar lack of reliable data for spills that occur while in transit due to equipment failures from causes other than motor vehicle accidents. Spills of this nature are included in the same data basis as loading/unloading spills listed earlier, and the same problems of completeness and representativeness are encountered when attempting to infer a spill rate from them.

The data to estimate the frequency of loading and unloading spills and spills that occur while in transit from causes other than motor vehicle accidents, was collected during the survey.

The literature with respect to the probability of a spill resulting from a motor vehicle accident is much better, and it is useful to review its highlights here.

4.1.1 Large - Truck Accidents

The three tables that follow show the comparative truck and passenger car accident rates for Ontario, Saskatchewan, and the United States. The accident rates have been converted to accidents per million VKT in order to make the data consistent.

TABLE 4.1

ACCIDENT RATES ON ONTARIO'S HIGHWAYS
(Accidents per 1,000,000 VKT)

Type of Road	1980		1981	
	All Vehicles	Truck	All Vehicles	Truck
Freeways	.7	.6	.8	.7
King's Highways	1.2	1.4	1.2	1.5
Secondary Highways	1.6	2.9	1.6	2.4
Tertiary Roads	*	*	1.8	*
Provincial Totals	.9	.9	1.0	1.0

* Not available

Source: Truck Transportation Office, Ministry of Transportation and Communications

Since the truck accident rates include all truck sizes from pickup trucks to road trains, it is not possible to confirm, from the available data, that large trucks have different accident rates than passenger cars in Ontario. However, disaggregated traffic accident statistics, such as those shown in Table 4.2 below, would indicate that large trucks have a lower accident rate than passenger cars.

TABLE 4.2

VEHICLE INVOLVEMENT RATES IN ACCIDENTS
ON SASKATCHEWAN PROVINCIAL HIGHWAYS 1980

Type of Vehicle	Number of Vehicles Involved in Accidents	Travel (million km)	Vehicle Involvement Rate*
Passenger Autos	4,321	3,061	1.41
Small Trucks (Pickups)	2,040	1,501	1.35
Straight Large Trucks (5,000 kg)	309	306	1.01
Semitrailer Units	502	367	1.37
Double Trailer Units	56	50	1.12
Total Large Trucks	867	723	1.20

* Obtained by dividing figures in the first column by those in the second column

Source: Popoff, A.J.; "Heavy Truck Involvement in Traffic Accident", Saskatchewan Highways and Traffic; November 1981.

Estimates of the national totals for the United States, based on truck accident data for 7 states, show a similar pattern to that for Saskatchewan.

TABLE 4.3

ACCIDENT RATES BY TYPE OF VEHICLE
UNITED STATES

Vehicle Type	1978 Estimate of all Accidents	1977 Estimate of Travel (million VKT)	Accidents per (million VKT)
Total Large Trucks	432,000	154,246	2.8
Combination Trucks	276,000	74,847	3.7
Single-Unit Trucks	173,000	79,399	2.2
Passenger Cars	5,793,000	1,804,649	3.2

Source: Najjar (1981) as reported in the study cited in footnote 3.

The accident rates shown in Tables 4.2 and 4.3 have the same pattern -- i.e. the large truck accident rate is approximately 13-14 percent less than the passenger car accident rate -- but the accident rates shown in Table 4.3 for the United States are higher than those shown in Table 4.2 for Saskatchewan by a factor of more than 2. The reason for this apparent anomaly is that the data for Saskatchewan are only for highways and the data for the United States are for all roads. This is consistent with Ontario data that show an accident rate of about 1.0 accident per million kilometres for main highways (Table 4.1) and 2.8 accidents per million kilometres (Table 3.9) when all provincial roads are included.

While the available evidence would suggest that large trucks are involved in fewer accidents than passenger cars for the same exposure (i.e. VKT), the consequences of large truck accidents are much more severe. In an analysis of large truck accidents in the United States during 1979 and 1980, it was determined that large trucks (trucks with GVW of more than 11,794 kg) were involved in 5.7 percent (385,000) of all police-reported accidents. Yet, they accounted for 11.8 percent (5,360) of all fatal accidents, in which

5,874 persons died.[3] The analysis was of accident reports contained in the National Accident Sampling System (NASS) and the Fatal Accident Reporting System (FARS), two of the most reliable sources of accident data available for North America.

Some other highlights of the report mentioned in the previous paragraph, which also included analysis of Bureau of Motor Carrier Safety accident data, are:

- o In fatal accidents involving large trucks, death is most often attributed to rollovers.
- o Sixteen (16) percent of large truck accidents occur at interchanges. Fewer accidents occur at on-ramps than off-ramps with the ratio being 701 to 840.
- o Twenty-five (25) percent of all large truck accidents that occur on ramps involve a rollover, while only 7 percent of large truck accidents that occur elsewhere involve a rollover.

To summarize the foregoing discussion: large trucks apparently have a lower accident-involvement rate than passenger cars, but the consequences of large truck accidents are more severe, and large trucks are particularly vulnerable to accidents at interchanges.

4.1.2 Characteristics of Tank Truck Accidents

Virtually all of the special wastes in liquid form and most of the sludges in the OWMC inventories (see Tables A.1, A.2 and A.3) are expected to be carried in tank trucks, and approximately a third of all solid special wastes are expected to be carried in dump trucks. Since approximately 80 percent of all special wastes will move in tank trucks, it is useful to examine the characteristics of tank truck accidents separately.

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3. Eicher, J.P.; Robertson, H.D.; and Toth, G.R.; "Large Truck Accident Causation"; DOT HS 806 300, July 1982.

TABLE 4.4

ACCIDENT RATES* BY CARGO AREA CONFIGURATION AND TRUCK TYPE

Cargo Area Configuration	TRUCK TYPE			COMBINATION TRUCKS	
	Single Unit	Single Unit with Full Trailer	Single Unit with Dolly	Single Trailer	Double Trailer
Full Enclosed	.23	.35	.90	.63	1.23
Enclosed, Low Bed	**	**	**	.37	1.19
Tank	.76	.47	**	1.22	4.77
Bulk Commodity	.94	**	**	.71	.72
Pole/Log	**	**	2.57	.12	**
Platform	.32	.30	.92	.62	1.78
Dump	1.37	.30	1.03	2.05	1.85
Vehicle Carrier	**	**	2.92	1.17	**

* Accidents per million vehicle kilometres travelled (original data were reported in accidents per 100 million vehicle miles travelled).

** Rare or nonexistent configurations.

Source: Vallette et. al. (1981) as reported in the study cited in footnote 3.

Accident rates for different configurations and types of trucks are shown in Table 4.4.

Care must be taken in drawing comparisons between the accident rates presented in Table 4.4 and those presented previously in this chapter. The accident rates in Table 4.4 are based upon data collected for all large truck accidents occurring on 78 roadway segments in six states. A total of 2,112 accident involvements were investigated. Assuming the study is internally consistent, the accident-involvement rate for all types of tank vehicles and dump trucks is higher than for fully enclosed (van) and platform trucks and trailers.

Data collected by the Ontario Petroleum Association (OPA) appears to show the same trend of slightly higher accident involvement rates for tank vehicles. These data are presented in Table 4.5.

TABLE 4.5

TANK TRUCK ACCIDENT RATES COMPARED TO ALL - VEHICLE ACCIDENT RATES (Accidents per million VKT)

Year	Tank Trucks	All Vehicle
1981	2.93	2.8
1980	3.56	2.7
1979	4.34	2.7
1978	4.93	2.7
1977	4.02	3.3
1976	4.48	3.3
1975	5.18	3.3

Sources: Tank truck accidents - Ontario Petroleum Association submission to The Ontario Commission on Truck Safety June 24, 1982.

All vehicle accidents - Ministry of Transportation and Communications, "Ontario Motor Vehicle Accident Facts"; various years.

While it is not possible to determine if the exposure -- the portion of total travel on each road type -- is comparable for the accident rates shown in the two columns of Table 4.5, the pattern is similar to the situation in the United States. The accident rate for gasoline tankers operating in the United States in the years just prior to 1978 was 4 accidents per million VKT.[4] This is slightly higher than the accident rate for all vehicles in the United States.

A survey of 131 tank truck accidents that occurred over a one year period, February 1, 1980, to January 31, 1981, on California highways was recently completed by the California Highway Patrol.[5] Comparisons between tank truck accidents and accidents involving other types of trucks are difficult to make since the report did not include VKT estimates and only limited registration data were available. However, the study did provide some interesting insights into the nature and characteristics of tank truck accidents. Some of the major findings of the California Highway Patrol Study are:

- Overturning accidents are the most common type of tank truck accident. Seventy-six (76) of the 131 accidents involved overturns. Overturns occurred in one quarter of accidents of trucks with empty tanks, slightly over half of those that were full, and three quarters of those that were 10 to 90 percent full,

- Tank truck accidents are more severe than other types of large truck accidents largely because of the higher incidence of overturning and post-crash fires.

- Sixty-nine (69) or 53 percent of the accidents resulted in a spill. Sixty-one (61) of the spill accidents involved an overturn, 8 did not.

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4. Rhoads, R.E., et al; "Assessment of the Risk of Transporting Gasoline by Truck"; PNL-2133; Battelle Pacific Northwest Laboratory, November 1978.

5. Heath, W.M., "California Tank Truck Accident Survey", California Highway Patrol, December 1981.

The first two findings listed above are generally consistent with analyses of Bureau of Motor Carrier Safety data.[6] The predominant vehicle accident casual factor appears to be that the high centre of gravity of a loaded tank vehicle makes it susceptible to overturn on interchange ramps and other curved roadways.

The third finding indicates a high probability of a spill following an accident of a tank truck. Since 20 of the 131 tank trucks involved in accidents were less than 10% loaded, the conditional probability -- the probability of a spill, given that a motor vehicle accident has occurred -- indicated from the California Highway Patrol data falls within the range of .53 and .62.

The estimate of the conditional probability of a spill of .53 to .62 appears to be higher than the true long-run probability. A review of the police reports of tank truck accidents that occurred in Ontario during 1980 gives an indicated conditional probability of a spill of between .05 and .27.[7] Some possible reasons for the difference are:

- Each of the estimates was based on a relatively small sample of 1 year and may not be representative of the long term. That is, California could have had a particularly "bad" year for tank truck accidents and Ontario a "good" year.

- The predominant type of tank vehicle in California is a truck and a full trailer, while the predominant type of tank vehicle in most other jurisdictions (including Ontario) is a tractor and semitrailer(s).

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6. See, for example:

   The report cited in footnote 3, or Davies, S. et al, "Analysis of Cargo Tank Integrity in Rollovers", DOT-FH-11-9193, October 1977.

7. Hickling Partners Inc., "Environmental Risk Associated With Implementation of Dangerous Goods Regulations", Report to Environment Canada, October 1981.

- o Exposure factors that affect accident frequency and severity, other than VKT, such as road type, climate, speeds, driver characteristics, etc. are not necessarily comparable in the two jurisdictions.

In a study carried out at the Battelle Pacific Northwest Laboratory to assess the risks of transporting gasoline by truck, it was estimated that about 1 in 15 accidents would result in a spill of more than 11,355 litres (3,000 U.S. gallons).[8] The overall truck accident rate used in the analysis was 4 accidents per million VKT which includes accidents on all types of roadways. However, the majority of the motor vehicle accidents that result in a spill occur on freeways and other high speed roadways where the overall accident rate is much lower -- usually less than 1 accident per million VKT.

The apparent discrepancy between the California Highway Patrol and the Battelle studies can be explained by the difference in exposure and spill sizes. All of the accidents analysed in the California study occurred on interstate highways, state highways, and county roads, but not on city streets. Approximately one half of the spills reported in the California studies involved releases of less than 3,000 U.S. gallons. If the Battelle results were adjusted for these differences in exposure and spill size, the indicated conditional probability of a spill given that an accident has occurred would be approximately .5.

The authors of the Battelle report reached virtually the same conclusion in that they found their results to be consistent with BMCS accident data which is shown below.

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8. See report cited in footnote 4.

TABLE 4.6

ACCIDENTS OF TANK TRUCKS CARRYING GASOLINE AND SIMILAR FLAMMABLE LIQUIDS DURING 1975

	Number
No. Spills	123
Spill; no fire	139
Spill; fire	34

Source: BMCS data as reported in the Battelle study, footnote 4.

The BMCS data would seem to indicate an even higher conditional spill probability. However, it should be noted that accidents involving empty tank trucks and those not involving death, injury, or property damage less than $2,000 are not included in Table 4.6. If they were, the indicated portion of accidents that result in a spill would be lower.

Since all of the travel on the transportation network described in Chapter 3 is on freeways and other highways, the expected accident rate for trucks carrying special wastes on them is less than the accident rate for all roads. However, the accidents that do occur can be expected to be more severe than average, and approximately half of the accidents involving a loaded tank truck can be expected to result in a spill.

4.2 ESTIMATING SPILL RATES FROM THE SURVEY

It is evident, from the discussion in the previous section, that estimating the spill rates, λ's, for the model from the literature has a number of shortcomings:

- The degree to which existing spill data bases are complete and representative is unknown and, therefore, reliable estimates of spill rates cannot be made from them.

- Of the several studies of tank truck accidents that include the determination of spill rates and are available in the open literature, none have been based on a sample of accidents that occurred in Ontario. Because of the difference in exposure variables such as vehicle type, highway types, climatic conditions, etc. between Ontario and the areas of study, the results of the studies do not necessarily apply to Ontario. Furthermore, the studies cover short time periods -- typically 1 or 2 years -- and the results are not necessarily representative of the long-run accident and spill experience.

An attempt to overcome these shortcomings was made in the survey of Ontario liquid waste carriers. The survey sample was chosen so that carriers who, in aggregate, handle at least 80 percent of all of the liquid industrial wastes that move under the Ministry of the Environment (MOE) waybill system would be included in the survey. These carriers were then asked, during the survey, to provide details of their accident experience for the five-year period, 1978-1982. Specific data that were collected are:

- Vehicle kilometres travelled for empty and loaded vehicles respectively.
- The number of vehicle loadings and unloadings.
- The number of involvements in motor vehicle accidents.
- The number and type of spills that occurred while handling and transporting liquid industrial wastes.
- Additional details for each spill that was reported.

By including the accident and spill data in the survey it was possible to overcome most, but not all, of the shortcomings of spill rate estimates in the open literature that were discussed above. The survey collected data retrospectively, and the historical transportation patterns of liquid industrial wastes are different than the expected transportation patterns for the volumes of special wastes in the 3 OWMC waste generation scenarios. The bulk of the liquid industrial wastes currently moving under the

MOE waybill system move in single unit vacuum trucks. There are some 73 licensed receivers in Ontario and, given this relatively large number, trucks do not, in most instances, have to travel great distances to dispose of the wastes they are carrying. Liquid waste carriers typically conduct most of their business within a 100 to 200 km radius of their home base. As a result of these transportation patterns, a relatively high portion of total VKT is at low speeds on urban roads. On the other hand, the special wastes in the 3 OWMC waste generation scenarios are to be transported to a single treatment facility. This means considerably longer trip lengths than for current movements of liquid industrial wastes, a high portion of VKT on freeways and other highways, and a shift from straight trucks to tractor/semitrailer combinations as the predominant tank vehicle type. The trend towards tractor/semitrailers is expected to occur because they are less expensive to operate per volume of cargo carried on long hauls than straight trucks. These changes in transportation patterns may result in slightly more transportation-related spills than the current experience with transporting liquid industrial wastes would indicate.

The survey covered a five-year period in order to ensure that the results would have a high probability of being representative of annual average spill rates. However, the records of the carriers interviewed were, in some instances, not available or complete enough to provide the data over the entire period. As a result, some of the responses to the portion of the questionnaire dealing with exposure and spill frequencies were incomplete or unreliable and had to be removed from the data base.

4.2.1 Survey Results

In a few instances carriers were able to provide good data for in-transit spills, but not for loading/unloading spills and vice versa. Therefore, it was necessary to use different sub sets of the surveyed carriers when analyzing in-transit and loading/unloading spills respectively.

4.2.1.1 In-Transit Spills

The motor vehicle accident and spill experience for the sample of carriers that provided usable data is summarized in Table 4.7, below.

TABLE 4.7

EXPOSURE, ACCIDENTS, AND SPILLS FOR A SAMPLE OF LIQUID WASTE CARRIERS 1978-1982

Vehicle Kilometres Travelled; loaded	5,280,000
Vehicle Kilometres Travelled; unloaded	5,050,000
Number of Motor Vehicle Accidents	20
Accident Rate (Accidents per million VKT)	1.9
Spills; as a result of truck accident	2
Spills; other in-transit	5

Source: Survey

Care must be taken in comparing the accident rate of 1.9 per million VKT and the number of spills shown in Table 4.7 to the accident rates and spill frequencies discussed earlier in this chapter. Any differences are likely due to differences in exposure -- i.e. the types of roads on which the VKT are accumulated -- than any differences in the operating practices and safety record of liquid waste carriers operating in Ontario.

Since, by definition, spills can only occur as a result of an accident if the accident occurs while the tank trucks are loaded, the indicated spill rate from the survey data is .4 spills due to motor vehicle accidents per million VKT and 1 spill per million VKT while in-transit due to causes other than motor vehicle accidents.

Details of the spills are shown in Table 4.8.

TABLE 4.8

DETAILS OF SPILLS WHILE IN-TRANSIT

Type and Number	Substance	Amount (litres)	Cause
Accident			
1	Mixed	4,000	Truck ran onto soft shoulder and rolled over
1	Waste oil	2,000	Jackknifed trying to avoid a 3 car accident ahead
Other In-Transit			
2	1 tank bottom, 1 paint sludge	Small amount	Liquid spilled from open container onto following car
1	Chrome and sulfuric acid	Small amount	Safety valve failed
1	Acid	4,500	Valve failed
1	Metal Hydroxide sludge and foundry sand	7.6 m^3	Tailgate on dump trailer sprang open

Source: Survey

4.2.1.2 Loading/Unloading Spills

Loading and unloading spills were defined as any spill large enough to require a special effort to clean up. Four loading spills that were reported were removed from the data base because of the small amount and nature of the substance involved on the spill. The number of loadings, unloadings, and spills for the survey sample are shown in Table 4.9.

TABLE 4.9

LOADINGS, UNLOADINGS AND SPILLS FOR A SAMPLE OF LIQUID WASTE CARRIERS, 1978-1982

	Number of Spills	Number of Loadings/ Unloadings	Spills per 10,000 Loadings/ Unloadings
Loading	3	31,500	1
Unloading	3	30,200	1

Source: Survey

From the survey data, the indicated spill rates are about one spill for every 10,000 loadings and one spill for every 10,000 unloadings.

Details of loading and unloading spills are shown in Table 4.10.

TABLE 4.10

DETAILS OF LOADING AND UNLOADING SPILLS

Type and Number	Substance	Amount (litres)	Cause
Loading			
1	*	50	Tank overflow
1	*	9	Plug missing from safety valve
1	Acid sludge	700	Incompatible acids mixed; load "boiled" over
Unloading			
1	Oily sludge	140	Hose coupling failed
1	Organic solvents	225	Storage tank overfilled
1	Chromic acid	900	Discharge rate too high, overflow at feed pipe

* Substance not identified to preserve confidentiality

Source: Survey

4.3 EXPECTED NUMBER OF SPILLS WHILE TRANSPORTING THE SPECIAL WASTES IN OWMCC SCENARIOS

The accident rates for the routes of the transportation network (Table 3.11) are generally less than 1.0 accidents per million VKT. Therefore, a spill rate of .4 spills per million VKT, as determined from the survey data, means that approximately one half of all motor vehicle accidents involving a loaded tank truck will result in a spill. Other in-transit spills and loading/unloading spills would be expected to occur at the same rate as those determined from the survey data. In summary the values of the parameters of the equations to calculate spill frequencies while transporting the special wastes in the three OWMC scenarios are:

- Motor vehicle accident rate: as shown in Table 3.10
- Conditional probability of a spill, given that a motor vehicle accident has occurred: 0.4
- Rate of in-transit spills as a result of causes other than motor vehicle accidents: 1 per million VKT
- Rate of spills during loading: 1 per 10,000 loadings
- Rate of spills during unloading: 1 per 10,000 unloadings.

With the exception of motor vehicle accident rates, all of the parameters listed above were determined from the survey.

Considering only the distances travelled while loaded, the expected exposure and spill frequencies are summarized in Table 4.11.

TABLE 4.11

ESTIMATED ANNUAL EXPOSURE AND ANNUAL, AVERAGE SPILL FREQUENCY TO TRANSPORT THE SPECIAL WASTES IN THE THREE OWMC SCENARIOS

Exposure/Spill Frequency	OWMC WASTE GENERATION SCENARIO		
	Low	Medium	High
Vehicle kilometres travelled (loaded)	1,123,000	2,230,000	3,578,000
Number of loadings	9,200	17,800	29,200
Number of unloadings	9,200	17,800	29,200
Motor vehicle accidents*	1 (1.005)	2 (1.98)	3 (3.28)
Spills from motor vehicle accidents	1 every 2 years	1	1 or 2
Other in-transit spills	1	2	3 or 4
Loading spills**	1	2	3
Unloading spills**	1	2	3
Total spills	3 or 4	7	10 to 12

Notes: * Figures in brackets are calculated values
** Does not include loading and unloading for local consolidations

The expected number of spills shown in Table 4.11 is small in comparison to the total number of spills of other materials -- such as petroleum products and chemicals -- that may be dangerous to the environment when spilled. For example, the accident rate reported by the Ontario Petroleum Association (Table 4.5) for 1981 represents 143 accidents and 48,680,000 vehicle kilometres travelled. Only a portion of these accidents would result in spills. However, since the probability of a spill is proportional to vehicle kilometres travelled, the expected number of spills of special wastes would be only a small fraction of the expected number of spills of petroleum products.

In the four years from 1978 to 1981, 224 road accidents that resulted in release of dangerous goods were reported to the Transport of Dangerous Goods Directorate.[9] This represents, on average, 56 spills per year that were reported. However, there is currently no legal requirement to report spills of dangerous goods and this number considerably understates the actual number of spills of dangerous goods that result from truck accidents each year. This compares to one spill per year of special wastes due to a motor vehicle accident that is expected for the medium volume scenario.

Complete and accurate data bases of spills of all types of dangerous materials do not exist and it is, therefore, not possible to put the expected spill frequencies shown in Table 4.11 into precise perspective. However, it is clear that, relative to the number of spills of dangerous goods, the expected number of spills of special wastes is small.

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9. Transport of Dangerous Goods Directorate, "Transportation of Dangerous Goods Act Impact Assessment", Transport Canada, November 1981.

5.0 THE EXISTING TRANSPORTATION INDUSTRY

5.1 INTRODUCTION

A major component of the research undertaken to prepare this report involved interviewing carriers currently engaged in the transportation of liquid industrial wastes. As discussed in Chapter 1, the 40 carriers that have provided input to this study transported a total of 83.3 percent of the 229,000 tonnes moved on MOE waybills in Ontario in 1982.

Data gathered through this interview process was used to develop accident probabilities, as discussed in the previous chapter. This information and the pricing data used in Chapter 6 to develop estimates of transportation costs are the two major analytical uses of the information gathered from the interviews. The rest of the information gathered on the current transporters of liquid industrial waste is purely descriptive. The descriptive data is simply presented here and no attempt has been made to draw any implications from the data.

5.2 INTERVIEW PROCESS

A total of 19 carriers were interviewed in person and a further 21 carriers were interviewed by telephone. The formal questionnaire used to conduct the interviews is contained in Appendix 1.2.

The information gathered through the interview process is presented in aggregate form here to protect the confidentiality of the data provided by the individual carriers. Where the inclusion of data would have been associated with a specific carrier by those knowledgeable about the industry, that information has been excluded from the report.

5.3 COMPANY BACKGROUND

Several areas were covered in this section of the questionnaire, to provide insights into the carriers that transport liquid industrial waste.

With respect to the age of the companies, most started in business during the 1970's, which corresponds with the increased concern shown by society in general with environmental matters.

Table 5.1 shows the portion of companies entering the industrial waste transportation business, by decade:

TABLE 5.1

DECADE IN WHICH COMPANY BEGAN WASTE TRANSPORTATION

Year Started	% of Respondents
1930 - 1939	3
1940 - 1949	14
1950 - 1959	11
1960 - 1969	19
1970 - 1979	49
1980 +	6

Numbers do not total 100 percent due to rounding.

In terms of total employment, the majority of liquid industrial waste carriers are relatively small, with 73 percent of the companies responding employing 15 or fewer full-time employees. Table 5.2 summarizes the responses with respect to full-time employees.

TABLE 5.2

NUMBER OF FULL-TIME EMPLOYEES

No. of Employees	% of Respondents
1 - 5	28
6 - 10	25
11 - 15	19
16 - 20	3
21 - 25	0
26 - 30	3
31 - 35	5
36 - 40	0
41 - 45	0
46 - 50	8
51 - 55	0
56 - 60	0
61 - 65	3
66 - 70	0
70 +	6

The larger carriers tended to be more active either in transporting materials other than waste or had diversified into nontransportation areas.

The bulk of the carriers was active in transporting materials other than those considered to be special waste. Only 24 percent of the carriers transported special wastes exclusively, with the remaining 76 percent being involved in the transportation of other materials.

Of those that were diversified, the majority were involved in transporting either septic tank waste or treated sewage (54 percent of those that were not solely carrying special wastes). Of the remaining diversified carriers, 8 percent were carrying material for recycling, and the remaining 38 percent were involved in transporting products, normally in bulk.

The proportion of the carriers' total business derived from the transportation of special wastes clustered around two extremes, either a low proportion or high, as shown in Table 5.3.

TABLE 5.3

PROPORTION OF BUSINESS DERIVED FROM TRANSPORTING SPECIAL WASTES

% of Business	% of Respondents	% of Business	% of Respondents
0 - 10	26	51 - 60	3
11 - 20	8	61 - 70	0
21 - 30	0	71 - 80	8
31 - 40	3	81 - 90	11
41 - 50	11	91 - 100	29

Those carries where the movement of special wastes represents a low proportion of their business have often added the activity as a service to an existing customer.

When asked about the prospect for growth of the special waste component of their business, most of the carriers were uncertain. While 53 percent of the carriers expected their special waste transportation business to grow, they do not see the volumes of special waste being transported increasing. Rather, they expect the total volumes of special waste being transported to decrease as generators increase their internal recycling of waste streams and reduce the volume of special wastes to be transported through preliminary treatment, primarily dewatering. As a result, those carriers that expect their special waste transportation to grow, plan to do so by increasing market share, not through an increase in the market size.

Of the remaining carriers, 15 percent expect special waste business to decrease and the remaining 32 percent expect their special waste business to remain about the same.

In virtually all cases, the carriers did not expect the overall economic recovery to lead to a corresponding increase in the volumes of special wastes being transported.

5.4 TRANSPORTATION EQUIPMENT

There are four basic types of equipment used to transport special wastes in bulk: straight tank trucks, tractor/tank trailer combinations, lugger trucks, and straight dump trucks. These basic vehicle types are represented schematically in Figure 5.1.

In Table 5.4 the total number of each vehicle type operated by the carriers is shown.

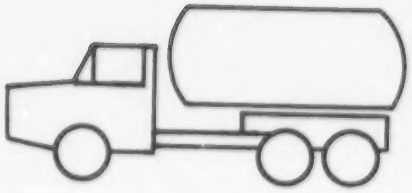
For the movement of packaged or drummed waste material, vans and flat deck trailers are used, either in a straight truck or tractor/trailer configuration.

At this time a very small portion of the movements are being made in drums. For the carriers surveyed, less than 1 percent of their movements would involve drummed material. Drums are not widely used for a number of reasons including, the current pricing structure does not favour them and landfill sites will not accept drums.

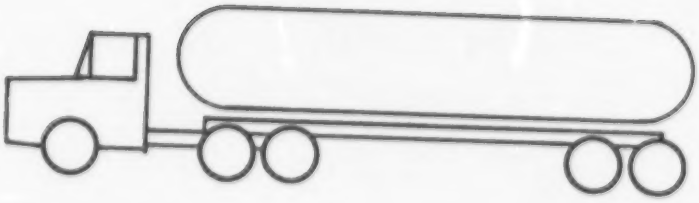
The basic vehicle configurations for lugger trucks and dump trucks are relatively standard across the carriers. The actual carrying capacity of a lugger truck is determined

FIGURE 5.1

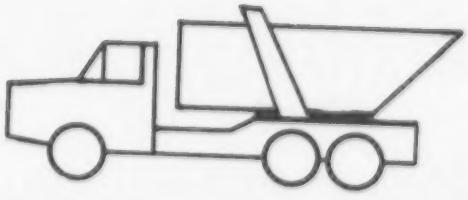
SPECIAL WASTE VEHICLE CONFIGURATIONS



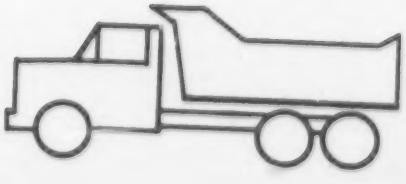
GVW: 28,300 kg
Carrying Capacity: 18,000 kg
(approximate) (maximum)



GVW: 47,500 kg
Carrying Capacity: 30,000 kg
(approximate) (maximum)



GVW: 28,300 kg - 47,500 kg
Carrying Capacity: 18,000 kg - 30,000 kg
(approximate)



GVW: 28,300 kg - 47,500 kg
Carrying Capacity: 18,000 kg - 30,000 kg
(approximate)

TABLE 5.4

SUMMARY OF TRANSPORTATION EQUIPMENT
USED BY CARRIERS INTERVIEWED

		Total	Lined	Insulated	ASME Certified
BULK EQUIPMENT					
Straight Tank Trucks[1]		126	3	--	16
Carbon Steel Tank Trailers		62	17	--	14
Stainless Steel Tank Trailers		44	2	2	7
Aluminum Tank Trailers		15			
OTHER VEHICLES					
Lugger Trucks		8			
Lugger Trailers		3			
Dump Trucks		4			
NONBULK EQUIPMENT					
Straight Trucks	Vans	4			
	Stakes	4			
Trailers	Vans	21			
	Flat Beds	8			
Tractors		76			

1. Includes dry vacuum boxes

by the size of the lugger box used with the truck. Lugger trucks and dump trucks are used primarily to transport either solid wastes, or wastes that have been dewatered prior to transport. Most of the carriers interviewed did not use these types of equipment as they were primarily engaged in the transportation of liquid industrial wastes.

Within tank trucks and tractor/tank trailer combinations there is a significant variety of equipment used, in terms of size of equipment and material of construction.

5.4.1 Material of Construction

There are three major materials used in the construction of tanks for straight trucks and trailers - mild carbon steel, stainless steel, and aluminum. Mild carbon steel tanks comprised 75 percent of the total tank vehicles operated by the carriers, stainless steel tanks: 18 percent; and aluminum tanks: 7 percent. Stainless steel and aluminum tanks were used only as trailers, not on straight trucks.

Mild carbon steel tanks are the least expensive, which is a major factor in their dominance of the fleet. The tanks are also suitable for carrying a wide variety of industrial wastes.

Stainless steel tank trailers sell for approximately one third more[1] than a comparable mild carbon steel trailer. The price differential is mainly accounted for by the higher cost of stainless steel, although there are also increased manufacturing costs incurred in using stainless steel. Stainless steel tanks are used for transporting specific liquid industrial wastes that cannot be transported in mild carbon steel tanks. From the interview data, the most popular use of stainless steel tanks is for the transportation of acid wastes.

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1. Interview with Mr. W. Stemmel, General Manager, Cusco Industries, a tank trailer manufacturer.

The major advantage of aluminum tanks is their lower weight relative to steel tanks. In transporting material with a high specific gravity, it is possible to carry a larger payload with an aluminum tank than a steel tank of the same size. (The higher carrying capacity results from the lower trailer weight, thus allowing for a higher payload before the maximum gross vehicle weight (GVW) is attained.) Aluminum tanks are not required from a compatibility with the waste being transported point of view.

In addition to the variety of materials used for the construction of the outer skin of the tank, there is also a variety of materials that can be used to line the interior of the tanks. Interior linings are used to protect the body of the tank from the material being transported. Most tanks have a basic epoxy lining that comes as a standard feature of the tank; however, some tanks have special rubber or glass linings added. Approximately 10 percent of the tanks operated by the carriers interviewed are equipped with a special lining. (The large number of unlined tanks would indicate that the linings are not required from a strict performance point of view. Rather, some carriers believe that the extra cost of the lining is justified because it will prolong the service life of the tank.)

A very small percentage of the tanks operated by the carriers (less than 1 percent) are insulated, so that the temperature of the material being transported can be maintained and thereby prevent a change in the physical state.

5.4.2 Tank Sizes

Tanks are not built to standard sizes, rather the tank truck and trailer manufacturers would appear to build units to order. Carriers are able to order their tanks to their specific needs and, as a result, there is a wide range of both tank truck and tank trailer sizes in use. From the survey data, straight tank trucks ranged in capacity from 3,600 to 18,900 litres (400 gallons to 4,200 gallons) and tank trailers from 9,000 to 40,300 litres (2,000 to 9,000 gallons).

While there is a range of sizes of tank used, gross vehicle weight laws impose weight constraints on the size of the loads moved. For straight tank trucks with three axles, the maximum allowable gross vehicle weight for Ontario is 28,500 kilograms. The tractor and

tank of a straight truck will weigh approximately 15,000 kilograms, leaving roughly 14,500 kilograms for payload. This would represent a tank capacity of 14,500 litres. Not surprisingly, 90 percent of the straight trucks have tanks of this size or less, with 78 percent of these between 10,800 and 15,000 litres. The relatively small number of tank trucks that are either small or large is likely dedicated to particular tasks.

The same pattern of size distribution is apparent in the trailer sizes. Early discussion has shown that the maximum payload carried by a five axle tractor trailer combination would be approximately 25 tonnes or 25,000 litres (5,500 gallons). From the sample, 62 percent of the tank trailers are smaller than 25,000 litres.

Those tank trailers that are larger than 25,000 litres would likely have 3 axles, which would increase the maximum gross vehicle weight to 56,000 kilograms, which would allow for a payload of approximately 40,000 kilograms or 40,000 litres (8,800 gallons).

5.4.3 Auxiliary Equipment

As an integral part of their transportation services, most carriers also provide loading services to the generators. In the case of lugger trucks, the lugger boxes are normally left at the generators' site. When the boxes are full, they are removed by the carrier and replaced with an empty one. Dump trucks are typically loaded using front end loading equipment, from a stockpile of material.

Tank trucks and trailers are often equipped with suction equipment for loading liquids and solids. The equipment used for loading works on a vacuum principal, which means that the material being loaded does not pass through the pump mechanism. Since the material is kept separate from the pump mechanism, it is possible to load liquids, sludges, and solids in this manner. (In some instances those interviewed indicated that their tank trucks were used as 'vacuum cleaners' to clean the interior of factories and the manufacturing equipment.)

Of the carriers interviewed, 100 percent of the straight tank trucks operated by the carriers are equipped with vacuum equipment. Of the tank trailers operated by the carriers, 23 percent were equipped with an independent vacuum system.

Tank trailers not equipped with an independent vacuum system are loaded in one of two ways:

- o The tractor pulling the trailer is equipped with either a pump or a vacuum system; or
- o Loading equipment is provided by the generator.

Pump systems cannot move the same range of materials as vacuum systems, since the material passes through the pump mechanism. As a result, pump systems are limited to moving liquids.

Unloading of the equipment is normally done by gravity. Both straight tank trucks and tank trailers can be equipped with hydraulic hoists to raise the tanks and allow for unloading. Alternatively, the vacuum or pump system can be used for unloading.

5.4.4 Equipment Life

The service life of transportation equipment is normally defined in terms of the total mileage accumulation expected for the equipment. However, in the waste business, transportation distances are currently relatively low with the result that the expected life of equipment is expressed in years instead of distances.

Table 5.5 provides a summary of the expected service life and the average age for the equipment used by liquid industrial waste carriers.

TABLE 5.5

AVERAGE AGE AND EXPECTED SERVICE LIFE FOR TRANSPORTATION EQUIPMENT

Type of Equipment	Average Age	Expected Service Life
Tank Truck Chassis	5 years	11 years
Stainless Steel Tanks	11 years	17 years
Carbon Steel Tanks	6 years	13 years
Tractors	6 years	10 years

The expected service life of the equipment reflects the current transportation patterns in the industry. Any significant change, such as an increase in distances travelled, would result in changes in the expected service life.

5.4.5 Equipment Trends

The long expected service life of the transportation equipment would indicate that there is very little technological change expected in the equipment.

Many of the carriers indicated that the average size of a load from many of the generators is decreasing, partly due to economic conditions and also through increased emphasis on waste management. As well, generators are attempting to reduce the cost of waste disposal through preliminary treatment of wastes, primarily dewatering. This results in a smaller number of shipments of higher density waste.

The smaller shipment sizes lead to a desire for compartmentalized tanks that can carry several different waste types in one trip. However, the increased density of the wastes means that the material does not flow as freely and there is an increased need for cleaning of the tanks. Compartmentalized tanks pose serious cleaning problems due to the difficulty of access. Currently non-compartmentalized tanks can be cleaned by opening the rear of the tank. It is likely that the number of rear opening tanks will increase in order to deal with materials of higher specific gravity. As a result of these conflicting factors, only 28 percent of the carriers surveyed expect to see higher use of compartmentalized tanks in the future.

The higher density of the waste streams will also lead to a demand for higher vacuum capabilities and may also lead to increased use of lugger equipment.

Many of the carriers indicated that they expect to see a trend towards more use of tank trailers as opposed to straight tank trucks. Currently 48 percent of the vehicles used for transporting liquid industrial wastes are straight tank trucks. However, 45 percent of the carriers surveyed indicated that they expect to make more extensive use of tractor/trailers in the future.

Thirty-eight percent of the carriers indicated that they expected to see larger tanks being used. However, the size of the tank is constrained by weight laws, as indicated earlier.

The most significant point to come out of the comments on equipment trends is the perceived trend towards transporting wastes with higher specific gravities.

5.5 DRIVER TRAINING

Thirty of the forty questionnaires were completed for this section.

The responses to the questions on driver training and safety are summarized in Table 5.6.

While the majority of the respondents has some form of driver training, these are typically in-house programs. There would not appear to be a formal structure to these programs, and the content and quality of the programs will likely vary from company to company.

5.6 PRICING

The price charged to the generator of transportation normally includes the cost of disposal of the waste. The major exception to this is when a carrier is used to transport waste to the generator's own disposal site.

TABLE 5.6

SUMMARY OF DRIVER TRAINING AND SAFETY EQUIPMENT RESPONSES

Do you currently have a formal training program for new drivers? (percent of drivers)

yes 55% no 45%

Does this program involve a checkout of the driver on the truck? (percent of drivers)

yes 62% no 38%

Does the program involve a description of the materials you transport and their hazards? (percent of drivers)

yes 55% no 45%

TABLE 5.6 (continued)

Does the program involve specific response instructions for emergency situations, such as: (percent of drivers)

spill from overfilling	yes	55%	no	45%
spill from motor vehicle accident	yes	55%	no	45%
spill from storage tanks	yes	55%	no	45%
fire	yes	55%	no	45%
spill into waterway	yes	47%	no	53%
skin exposure/eye contact	yes	55%	no	45%

other (please specify) it
Notify Proper Authorities - one response

Do your drivers receive, or are t[illegible]equired to have, first aid training? (percent of drivers)

yes 14% no 86%

How do you conduct the training program for new drivers? (percent of drivers)

within your company	51%
by outside group (specify)	4%
combination	0%
no formal program	45%

What safety equipment is carried on your vehicles: (percent of companies)

gloves	100%	goggles	70%
rubber suits	40%	filter masks (particulate)	47%
ear plugs	37%	filter masks (toxic)	37%
helmets	93%	fire extinguisher	100%
safety glasses	97%	breathing apparatus	23%

Are you aware of any program offering formal training that would be useful to your drivers? (percent of companies)

yes 37% no 63%

If yes, please specify:

Ontario Trucking Association Program: 4 responses

Transportation Safety Association: 2 responses

Industrial Accident Prevention Association: 2 responses

Universities: 2 responses

Are you aware of any regulations, either existing or proposed, relating to driver training? (percent of companies)

yes 20% no 80%

If yes, please specify

Department of Transport, U.S.: 5 responses

Ministry of the Environment: 1 response

Since the disposal costs are part of the transportation costs paid by the generator to the carriers, the carrier normally selects the disposal site for the waste, not the generator.

All of the carriers interviewed stated that the industry is extremely competitive, with dominant selection criteria used by the generators being price. Carriers compete on price in two ways which are not exclusive. The first is through the price they charge for transportation, and the second is through finding the least expensive method of disposal.

From the generators' point of view, the carriers offer a basic, nondifferentiated service, thus the importance of price.

In an attempt to lower the costs of disposal and, to a certain extent, differentiate their service, some of the carriers have diversified to offer treatment, recycling, or waste exchange services.

The price of the transportation offered by the carriers is normally charged on a time rather than a volume or distance basis. This reflects the relatively high loading and unloading time compared to travel time using existing treatment and disposal facilities. The cost of treatment and/or disposal is charged on a volume basis, with different rates for the various types of waste streams.

Pricing information was provided by 22 of the carriers surveyed. (A total of 34 carriers provided pricing information, but for 12 the information was highly customer specific and was not representative. Three of the carriers surveyed were private carriers that transported only their own wastes.)

The prices charged for transportation varied by the type and size of equipment and by carriers. The charges are summarized in Table 5.7.

TABLE 5.7

TRANSPORTATION CHARGED BY EQUIPMENT TYPE (per hour)

		Low		High
Straight Tank Truck		$37.75		$ 74.40
Tractor/Tank Trailer:	Vacuum Tank	$55.00		$ 96.50
	OtherTank	$42.50		$ 50.00
	Stainless Steel Tank		$115.00	
Dry Vacuum Box		$96.50		$115.00
Lugger Trucks			$ 59.00	

As can be seen, there is significant variation in the prices charged by the carriers. One explanation for the variation is the size of the equipment being quoted. However, it is also likely that competitive factors have led to some carriers charging less than their actual long run costs of providing the service.

6.0 TRANSPORTATION COSTS

6.1 INTRODUCTION

This chapter presents estimates of the cost of transporting special wastes from all parts of the province to the hypothetical location of the treatment facility.

In developing the cost estimates, only for-hire transportation is considered, although two separate estimates are provided. The first estimate is based upon current industry practice, where there is no charge for the backhaul. In the second estimate, backhaul costs have been added for trips of greater than 1.5 hours.

The for-hire costs include line-haul travel, and all relevant loading and unloading times. No estimate is made here of the costs of local consolidation of shipments within municipalities.

6.2 FOR-HIRE TRANSPORTATION COSTS

For the purpose of calculating costs, it has been assumed that all movements will take place using a tractor-trailer combination. From the survey data and discussions with generators and carriers of solid wastes, the following time and cost estimates were derived:

- Rates provided by 13 industrial liquid waste carriers for a tractor-trailer combination ranged from $55 per hour to $96.50 per hour. The average, weighted by volume moved, was $72 per hour. This rate was used to calculate the costs of liquid and sludge special waste movements.

- Insufficient data was collected to calculate a separate rate for solid special wastes. Data published in Operating Costs of Trucks in Canada 1982 indicates that the operating costs would be similar for all hold operations. As a result, the same rate of $72 per hour was used in calculating dry special waste transportation costs.

- The loading and unloading times of liquid wastes are assumed to be 1 hour each.

- The loading and unloading times of solid special wastes are assumed to be one half hour each.

It should be noted that the $72 per hour charge is based upon current transportation practices in which travel distances are relatively short. With all wastes being transported to one central location (as assumed in this analysis) transportation costs may increase since carriers would be faced with longer empty backhauls.

Based upon these assumptions, the cost of for-hire transportation for the three volume scenarios was calculated as:

Low Volume	$2,608,000
Medium Volume	$4,943,000
High Volume	$8,209,000

Detailed calculations of these costs are shown in Tables A.15 - A.18.

Transportation costs are dependant upon the location of the treatment facility, since this will determine the total amount of travel time required. Thus the costs calculated here apply only to the configuration of the special waste treatment facility in this report. As such, the discussion of for-hire transportation is really only an example of low for-hire transportation costs would be calculated.

6.3 BACKHAUL CHARGES

Based upon the comparatively long (relative to current) haul distances, it is probable that there will be an increase in for-hire charges to compensate for the longer, empty backhauls.

To illustrate the potential magnitude of such a change in transportation charges, backhaul charges have been calculated for all trips of over 1.5 hours duration. The backhaul charges have been calculated based upon the $72 per hour charge. Extra time charges that would be billed for the low, medium and high volume scenarios respectively, are; 8,200, 16,500 and 26,200 hours. These will add an estimated $590,000, $1,188,000 and $1,886,000 to the transportation costs, bringing the total estimated costs to; $3,190,000, $6,131,000 and $10,095,000 for the low, medium and high volume scenario.

7.0 LEGISLATION AFFECTING THE TRANSPORTATION OF SPECIAL WASTES

Existing and proposed legislation at the federal, provincial, and municipal level that affects the transportation of special wastes are described in this Chapter.

7.1 FEDERAL LEGISLATION: THE TRANSPORTATION OF DANGEROUS GOODS ACT

7.1.1 Intent of the Legislation

The Transportation of Dangerous Goods Act, promulgated by Transport Canada, received third reading in October of 1980. The purpose of the Act is to:

- Eliminate conflicts, contradictions, inconsistencies, duplications, and gaps in the previously uncoordinated Acts and Regulations of the various Ministries which affected the transportation of dangerous goods; and

- Through the Regulations to the Act, promote the safe transportation of dangerous goods through the transmission of information regarding the goods being transported, and ensure reasonable safety standards are met.[1]

Many of the regulations being proposed for the Act are not new, rather, simply a consolidation of several sets of existing regulations. The regulations with respect to wastes are new, however.

Although the Act is federal legislation and normally would not apply to intraprovincial highway transportation, Ontario has indicated it intends to adopt the federal regulations.

The regulations have been divided into three units, with each unit covering different aspects of the regulations, as follows:

Unit I: Covers interpretation of terms, classification of goods, exemptions, documentation and safety markings;

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1. Appendix to the Canada Gazette, Part 1, Saturday, June 19, 1982

Unit II: Covers safety standards for containment, safety requirements respecting handling and transportation, prohibitions and limitations, training and education, and accident notification procedures; and

Unit III: Covers administrative procedures with respect to inspectors, applications for permits and ticketing offences.

Unit I of the regulations received first reading in June of 1982 and is currently being revised based upon public comment. It is anticipated that the first unit regulations will receive final reading in late 1983. The timing of Units II and III is uncertain at this time; however, it is anticipated that the regulations will be final by mid 1985.

While the regulations are not yet in their final form, it is still possible to discuss the areas that they will affect, in general terms.[2]

7.1.2 Classes of Dangerous Goods

There are nine classes of dangerous goods classified by the federal regulations. These are:

Class 1	Explosives
Class 2	Compressed Gases (Flammable, Non-flammable and Poisonous)
Class 3	Flammable Liquids
Class 4	Flammable Solids
Class 5	Oxidizers/Organic Peroxides
Class 6	Poisons
Class 7	Radioactives
Class 8	Corrosives
Class 9	Miscellaneous

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2. The discussion of the federal regulations is based upon previous work of the author, contained in, Transportation of Dangerous Goods Act, Incremental Transaction Cost Analysis, Peak Marwick & Partners, January 1982.

Within Class 9 there are three groupings of dangerous goods which are environmentally harmful or hazardous to human health. Class 9.2 consists of 67 toxic chemicals, and Class 9.3 consists of 97 specific waste streams that represent a potential environmental or health hazard. Class 9.1 is comprised of miscellaneous, typically small quantity materials.

The regulations with respect to the transportation of either a liquid or solid dangerous waste come into effect whenever:

- o One of the 97 waste streams is transported, or
- o Whenever a product in Class 1 through 9, with the exception of Class 7, is to be disposed of as a waste for any reason.

The regulations, with respect to the transportation of waste, do not apply when any of the dangerous goods are to be reused or recycled.

7.1.3 Impact of the Regulations

The proposed federal regulations will have an impact upon a number of areas dealing with transportation of dangerous, hazardous or special wastes. (The terminology of the federal regulations deals with dangerous and hazardous substances as opposed to special). The major areas of impact in transportation are:

- o Documentation Requirements
- o Marking Requirements
- o Equipment Requirements
- o Packaging Requirements

As well as these specific areas, there are other areas of potential impact of the federal regulations in terms of enforcement and ticketing offences which have not been developed at this time.

Each of the areas of potential impact is discussed on the following page.

7.1.4 Documentation Requirements

An integral part of the regulation of the transportation of dangerous wastes is the creation of a waste management system. To accomplish this, the regulations propose the use of a manifest - very similar to the waybill currently in use in Ontario. The manifest would contain the following information.

Consignor (Generator)

- o company name, business address;
- o address and name of consignee;
- o description of the hazardous waste, which will include the following:
  - product identification number,
  - hazard class,
  - quantity,
  - description of physical state,
  - number of packages,
  - special emergency handling instructions;
- o signature of authorized person;
- o date of shipment.

Carrier

- o Company name and address;
- o waste hauler number;
- o the vehicle trailer and license number;
- o signature of driver.

Consignee (Disposal Site)

- o company name and address;
- o location of the site;
- o site identification and approval number;

- o description of the hazardous waste received, including quantity and handling code;
- o date of receipt;
- o signature of responsible person.

The responsibility for completing the manifest lies with the consignor (generator).

The manifest would consist of six copies, distributed as follows:

- o two copies of the form remain with the consignor: one copy is kept on file for two years, the other is sent to the provincial environment ministry;
- o four copies of the form travel with the carrier;
- o upon arrival at the consignee, the carrier retains one copy of the form to be filed for two years,
- o the consignee receives three copies of the form: one copy is filed for two years, one copy of the form is returned to the consignor by mail and one copy of the form is sent to the provincial environment ministry.

The proposed federal manifest form differs from the current Ministry of the Environment (MOE) waybill in the following ways:

- o Currently, the Ontario form deals only with industrial liquid wastes, while the federal form would deal with solids and liquids;
- o The current MOE waste classification system is based upon general discriptions developed over time, while the federal identification of wastes will be based upon the United Nation classification system;
- o The current MOE system does not include a description of the hazard class of the waste being transported;

- o The current MOE form consists of only five copies, which the proposed federal form consists of six copies. Currently, there is no provision in Ontario for the waste disposal site to return a copy of the form to the generator;

- o The current MOE form does not require the inclusion of special emergency instruction; and

- o Currently the file copies of the generator, carrier, and receiver are retained for one year.

The MOE waybill is currently being revised. Under the proposed amendments to the waybill, it would be expanded or changed as follows:

- o The waste classifications being proposed under the revised waybill will be based upon the U.N. classifications;

- o Include solid wastes (referred to in the proposed regulation as site specific);

- o Include six copies - including the copy to be sent from the disposal site to the generator;

- o Lengthen the period of retention of the file copy to two years; and

- o While not necessarily being part of the waybill, a set of special handling and emergency response instructors will accompany each movement.

With respect to the types of waste required to be waybilled, the proposed federal regulations and the revised provincial waybill will be consistent. If there is any discrepancy, it will likely be that the provincial waybill covers a greater range of wastes than do the proposed federal regulations.

7.1.5 Marking Requirements

There are two safety marking requirements proposed under the federal regulations, individual packaging markings and vehicle placarding.

The majority of wastes move is bulk, which eliminates the need for package marking. (Operators of MOE controlled, service landfill sites currently do not accept solid wastes in other than bulk, and liquids are primarily moved in bulk tanks.)

With respect to placarding, the federal regulations require that any vehicle carrying any of the 97 specified waste streams in bulk have four of the appropriate placards on the vehicle - one on the nose, one on each side, and one on the rear. The specified placard for the specific waste streams is a red exclamation mark on a white background. The placard must:

- Measure at least 250mm on each side;
- The surface must have a retroreflectivity rating of not less than Level 2 as established in CGSB Specification 62-GP-11M dated May 1978; and
- Be sufficiently durable.

With respect to dangerous goods in Classes 1 through 8 that are to be disposed of as waste, the vehicle transporting these substances must be placarded in accordance to the requirements of the particular class.

All of the proposed placards for Classes 1 through 9 of dangerous goods are shown in Exhibit 7-1.

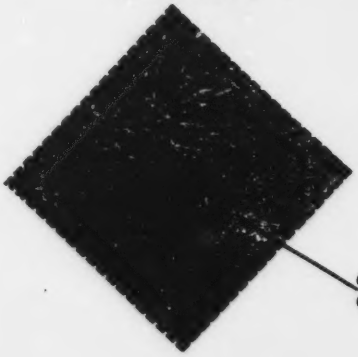
EXHIBIT 7.1

PLACARDING REQUIREMENTS FOR THE TRANSPORTATION OF DANGEROUS GOODS ACT

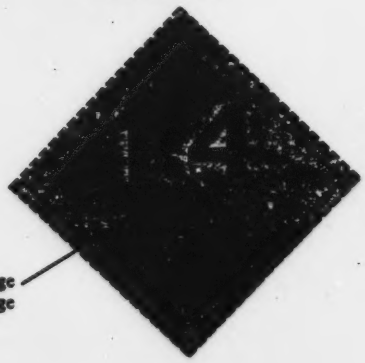
Placards/Plaques
(s./art. 69)

EXPLOSIVES/EXPLOSIFS

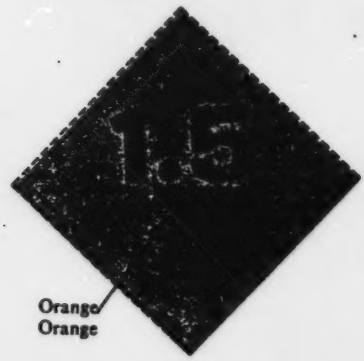
CLASS 1/CLASSE 1
DIVISIONS 1-3



CLASS 1/CLASSE 1
DIVISION 4



CLASS 1/CLASSE 1
DIVISION 5



• Division number and compatibility group/Numéro de la division et groupe de compatibilité

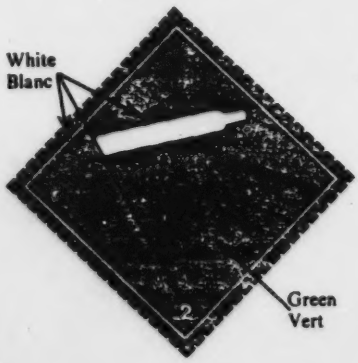
Δ Compatibility group/Groupe de compatibilité

FLAMMABLE GAS
GAZ INFLAMMABLE

CLASS 2/CLASSE 2
DIVISION 1

NON-FLAMMABLE,
NON-POISONOUS GAS
GAZ ININFLAMMABLE
NON-TOXIQUE

CLASS 2/CLASSE 2
DIVISION 2



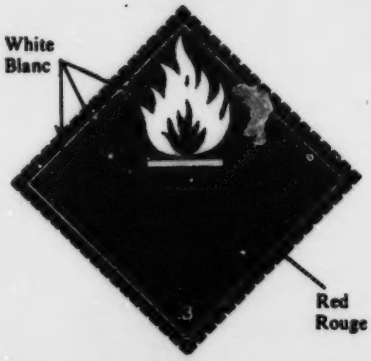
POISON GAS
GAZ TOXIQUE

CLASS 2/CLASSE 2
DIVISION 3

EXHIBIT 7.1 (continued)

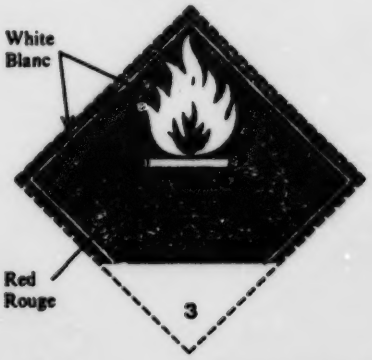
FLAMMABLE LIQUID
LIQUIDE INFLAMMABLE

CLASS 3/CLASSE 3
DIVISION 1



COMBUSTIBLE

CLASS 3/CLASSE 3
DIVISION 2



FLAMMABLE SOLID
SOLIDE INFLAMMABLE

CLASS 4/CLASSE 4
DIVISION 1

SPONTANEOUSLY COMBUSTIBLE
INFLAMMATION SPONTANÉE

CLASS 4/CLASSE 4
DIVISION 2

DANGEROUS WHEN WET
DANGEREUSE AU
CONTACT DE L'HUMIDITÉ

CLASS 4/CLASSE 4
DIVISION 3

OXIDIZER AND ORGANIC PEROXIDES
COMBURANT ET PEROXIDE ORGANIQUE

CLASS 5/CLASSE 5
DIVISIONS 1-2

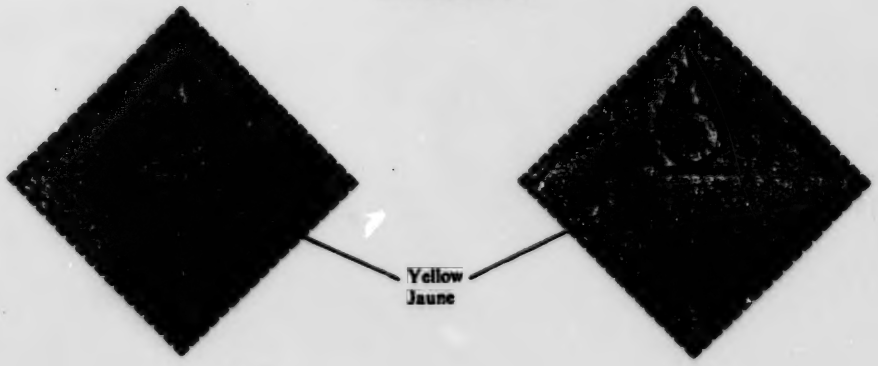


EXHIBIT 7.1 (continued)

POISON
TOXIQUE

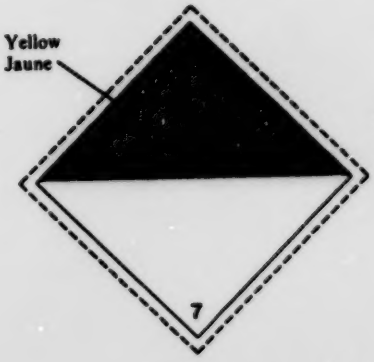
CLASS 6/CLASSE 6
DIVISION 1
GROUPS/GROUPES I-II

HARMFUL
NOCIF

CLASS 6/CLASSE 6
DIVISION 1
GROUP/GROUPE III

RADIOACTIVE MATERIALS
MATIÈRES RADIOACTIVES

CLASS 7/CLASSE 7



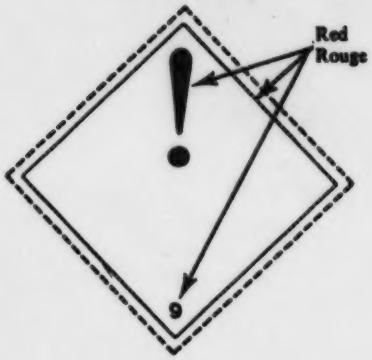
CORROSIVE
CORROSIVE

CLASS 8/CLASSE 8

EXHIBIT 7.1 (continued)

MISCELLANEOUS DANGEROUS GOODS
MARCHANDISES DANGEREUSES DIVERSES

CLASS 9/CLASSE 9



MIXED LOADS AND GOODS IN LIMITED QUANTITIES OR CONSUMER COMMODITIES
CHARGEMENT EN COMMUN ET MARCHANDISES DANGEREUSES EN QUANTITÉS LIMITÉES OU BIENS DE CONSOMMATION

EMPTY/VIDE

7.1.6 Packaging Requirements

As noted above, the majority of wastes are expected to be transported in bulk, and, therefore, are not affected by the packaging requirements.

Where wastes are packaged for disposal, it is anticipated that the current packaging practices will satisfy the requirements of the regulations.

7.1.7 Equipment Requirements

It is expected that the federal regulations will adopt the Canadian Standards Association's standard: CSA Preliminary Standard B.338, 1982, Highway Tanks and Portable Tanks for the Transportation of Dangerous Goods.

Currently these standards do not include vacuum tank trucks, which are used extensively in the transportation of liquid wastes. A revised standard is currently being developed to include vacuum tanks. These standards are currently not available, but it is likely the standards will aim to ensure compatibility of the transportation equipment and the nature of the wastes being transported.

7.1.8 Other Areas of Impact

The other potential areas of impact of the proposed federal regulations deal with:

- Accident notification
- Application for trucking permits;
- Inspection procedures; and
- Penalties for non-compliance

These have not been discussed, as the regulations governing these areas are currently at the preliminary stage.

7.2 PROVINCIAL LEGISLATION

There are two provincial ministries involved in legislation that will directly affect the transportation of special wastes in Ontario: the Ministry of Transportation and Communications and the Ministry of the Environment.

7.2.1 Ministry of Transportation and Communications

The Ministry is responsible for The Dangerous Goods Transportation Act, 1981 (Bill 93). The Act received third reading on December 18, 1981; however, it has not yet been proclaimed.

Basically the Act is enabling legislation that is intended to make the federal regulations under the Transportation of Dangerous Goods Act applicable to intraprovincial highway movements.

Like the Federal Act, the Provincial Act consolidates several pieces or appropriate sections of legislation - specifically the Boilers and Pressure Vessels Act, the Gasoline Handling Act, the Highway Traffic Act, the Energy Act and the Pesticides Act - under one Act.

When the federal regulations are complete, they will be adopted to form the basis of the provincial regulations.

The timing of the implementation of the Act is obviously dependent upon the timing of the federal regulations, which have been discussed above.

7.2.2 Ministry of the Environment

The Ontario Ministry of the Environment is responsible for developing and administrating regulations under the Environmental Protection Act. The Environmental Protection Act is a comprehensive legislation covering virtually all aspects of environmental concerns. There are primarily two sections of the Act that are relevant to the transportation of special wastes;

- o Part V, Waste Management, covering articles 24 through 47; and
- o Part IX, Spills, covering articles 79 through 112.

In addition to the relevant sections of the Act, there are also the regulations pertaining to the appropriate sections of the Act.

7.3 CURRENT MOE REGULATIONS

Like many of the other regulations pertaining to the transportation of special wastes, the MOE regulations are currently being revised. As a result, this discussion will cover both the existing Act and accompanying regulations as well as the proposed changes to the regulation.

7.3.1 Waste Management

Under the Waste Management section of the Act, the current regulations are:

- o Regulation 309 (General), formerly Regulation 824; and
- o Regulation 313 (Transfers of Liquid Industrial Waste), formerly Regulation 926/76.

7.3.2 Regulation 309

Under Regulation 309 there are standards specified for Waste Management Systems, specifically directed towards carriers involved in transporting special wastes, as follows:

14-(1) The following are prescribed as standards for the operation of a waste management system:

1. All waste collection vehicles and waste carriers shall be so constructed as to enable waste to be transferred safely and without nuisance from storage containers to the vehicle.

2. Bodies of waste collection vehicles and waste carriers shall be so constructed as to withstand abrasion and corrosion from the waste.

3. Bodies of waste collection vehicles and waste carriers shall be leakproof and covered where necessary to prevent the emission of offensive odours, the falling or blowing of waste material from the vehicles or the release of dust or other air-borne materials that may cause air pollution. R.R.O. 1970.Reg 824.s. 14 (1): O.Reg. 217/73, s. 8 (1).

As can be readily seen, the regulations are general in nature and do not represent an onerous burden to ensure compliance on the part of the carriers.

7.3.3 Regulation 313

Regulation 313 covers three major areas:

- Definition of Liquid Industrial Wastes;
- The Operation of the Waybill System; and
- Certification of Carriers.

Each of these areas is discussed below. A copy of the regulation is shown in Appendix C.

7.3.4 Definition of Liquid Industrial Wastes

Under Regulation 313, the mechanisms of the existing waybill system, the current regulations deal only with the transportation of liquid industrial waste, which is defined in general terms as opposed to a specific description of the wastes to be considered. Liquid industrial waste is defined as:

(b) "liquid industrial waste" means liquid waste that is a product of.

(i) an enterprise or activity involving industrial, manufacturing or commercial processes or operations.

(ii) research or an experimental enterprise or activity, or

(iii) an enterprise or activity to which subsclause (i) would apply if the enterprise or activity were carried on for profit.

but does not include:

(iv) waste that is a product of a sewage system to the provisions of Part VII of the Act or a sewage works subject to The Ontario Water Researces Act or waste that is removed from a holding tank to which regulations made under clause a or b of subsection 3 of section 94 of the Act apply.

(v) waste discharged by its producer at the site where the waste is produced into municipal sanitary sewage works in accordance with applicable by-laws or into a sewage system, as defined in Part VII of the Act, that is being operated in accordance with the Act.

(vi) waste disposed of at a waste disposal site as defined in Part V of the Act, operated by the producer of the waste and located on the site where the waste is produced, or

(vii) waste that is wholly reused or recycled.

The definition does not distinguish between liquid industrial waste that is dangerous, hazardous, or relatively innocuous, but rather from a transportation standpoint treats all liquid industrial wastes in the same manner.

Since the regulations came into effect in 1977, through a series of consultations with generators, carriers, and internal discussions, the MOE has developed a set of 21 broad liquid waste categories, which are then further subdivided into specific wastes. A total of 181 liquid waste streams are identified, as shown in Appendix D.

7.3.5 The Operation of the Current Waybill System

The operation of the waybill system has been described earlier in the discussion of the Transportation of Dangerous Goods Act. The waybill functions as a control mechanism, monitoring disbursements from liquid industrial waste generators and receipts by disposal sites, to ensure that liquid industrial wastes are being disposed of at sites approved by the MOE.

7.3.6 Certification of Carriers

Certification of carriers is done by the Environment Approvals Branch of MOE, which is also responsible for the approval of transfer stations and disposal sites.[3] With respect to carriers, there are six types of transportation certificates that are issued by MOE:

- Domestic,
- Commercial,
- Industrial,
- Hauled Liquid Industrial,
- Solid Hazardous, and
- Other.

Any carrier involved in the transportation of special waste would likely require a hauled liquid industrial and/or a solid hazardous certificate, although it is possible that some carriers operating with an industrial certificate may transport these wastes to a secure disposal site.

All certificates issued by MOE in this area are a "Provisional Certificate of Approval for a Waste Management System" by one of the above six categories. The certificates remain as provisional certificates and can be revoked by the Ministry for sufficient cause. (In some instances temporary certificates are issued for the completion of a specific task, and these certificates lapse after a stated period of time.)

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3. The description of the certification process is based upon discussion with L. Gregusch, Waste Sites and Systems Approvals, Environmental Approval Section, MOE.

In order to obtain a certificate of approval, the carrier must complete the "Application for a Certificate of Approval for a Waste Management System" and the "Supporting Information to an Application for a Waste Management System", copies of which are in Appendix E.

The completed forms are forwarded to the District MOE office where they are reviewed and then sent to the Toronto office, with a District Officer's recommendation. Final decision on the issuance of a certificate is made by the Toronto office.

In order to be approved, the carrier will:

- Identify the waste types that they plan on transporting;
- Indicate where the wastes it intends to handle will be disposed of and in what volumes. MOE will verify with the proposed disposal site that they can handle the wastes in the indicated volumes; and
- Provide proof of vehicle insurance in the amount of $1,000,000.

As well, the MOE District Officer will assess the capability of the carrier to perform the transportation adequately. This is not a formal review but is based upon the District Officer's understanding and knowledge of the region, the carrier, and the requirements of performing the transportation function. The District Officer may also inspect the equipment that the carrier proposes to use, to ensure that it is adequate. However, the lack of vehicle specifications in the current regulations requires that the District Officer determines the adequacy of the equipment independented.

Based upon the application and the recommendation of the District Officer, a certificate will either be issued or denied. In the case of denial, the carrier can appeal the decision.

Approval of an application is normally accompanied by a set of conditions, governing the use of the certificate. In the case of a hauled liquid industrial waste and a hazardous

solid certificate, a normal condition is that the certificate be used only as specified in the application. This means that the carrier must formally request authority to handle different wastes, change disposal sites, expand the geographic area of operation, etc. In this way MOE is able to monitor and, to a certain extent, control the ongoing activities of the carrier.

In the case where a carrier changes its name, acquires another company, or consolidates its operations, the requirement is to file a new application.

The approval process for transfer stations is similar to that for carriers. However, there may be a requirement for a public hearing in the case of a transfer station, under the Environmental Protection Act.

7.3.7 Spills

The legislation with respect to spills was added to the Environmental Protection Act in 1979, when Bill 24, An Act to Amend the Environmental Protection Act, 1971, received third reading. Although the amendments have received third reading and have been intergrated into the Act, they have not yet been proclaimed as the regulations are not yet in final form.

The intention of the legislation pertaining to spills is to ensure a duty to take corrective action after a spill occurs. While in the majority of cases where a spill occurs, cleanup action currently is undertaken, there is no law which requires that a cleanup be done. The legislation creates a legal responsibility for cleanup to be done by the polluter (defined as the owner and/or the person who had control of the pollutant immediately prior to the spill) regardless of fault or negligence.

In the wording of the Bill this requirement is stated as:

81: (1) The owner of a pollutant and the person having control of a pollutant that is spilled and that causes or is likely to cause adverse effects shall forthwith do everything practicable to prevent, eliminate and ameliorate the adverse effects and to restore the natural environment.

(2) The duty imposed by subsection (1) comes into force in respect of each of the owner of the pollutant and the person having control of the pollutant immediately the owner or person, as the case may be, knows or ought to know that the pollutant is spilled and is causing or is likely to cause adverse effects. R.S.O. 1980, c.141, s. 81.

This initiative is being strongly opposed by the business community at large because it requires that the cleanup be performed regardless of fault and imposes an unlimited absolute liability upon the polluter.

The legislation also provides to the Minister of MOE the power to direct the cleanup requirements, power which the Minister already has under other sections of the Environmental Protection Act. However, the new legislation then goes one step further to give the Minister the authority to order the participation of the appropriate people; corporations, municipalities, etc. in the cleanup operation.

Those individuals or groups, with the exception of the polluter, have a right to compensation from the Crown for the cost of their services in the cleanup operation.

The legislation also creates the Environmental Compensation Corporation, an agency to which those adversely affected by a spill can apply to for compensation. There is a set of criteria that must be met to be eligible for compensation, as well as limitations on the amount of the compensation to be paid.

7.4 PROPOSED REVISIONS OF EXISTING MOE REGULATIONS

MOE has proposed amendments to the "Transfers of Liquid Industrial Waste" (Regulation number 313), under the title "Transfer of Liquid Industrial Waste, Site-Specific Waste and Hazardous Waste". The regulations have been expanded to include site-specific and hazardous wastes as well as liquid industrial waste. The definition of these two additional types of waste are dealt with in a subsequent section of this chapter.

In the previous discussion of the Transportation of Dangerous Goods Act and its regulations, most of the major changes with respect to the operation of the waybill have been discussed. These proposed changes are summarized in Exhibit 7.2, and the proposed regulations are included as Appendix F.

7.5 PROPOSED REGULATIONS

There are no regulations currently for the Dangerous Goods Transportation Act nor the Act to amend the Environmental Protection Act (Bill 24), so there can be no changes to these regulations. There will be regulations introduced for both of these pieces of legislation - in the case of the Dangerous Goods Transportation Act, the regulations will likely be the same as the federal regulations for the Transportation of Dangerous Goods Act, and, in the case of Bill 24, the regulations will be written by MOE.

Currently MOE is in the process of preparing draft regulations for Bill 24. These draft regulations will serve as a basis for discussion within government and with industry to form the basis for the final regulations. The amount of time required for this process is not clear, and MOE officials are uncertain as to when the regulations will be finalized.

In the draft regulations the major emphasis is on:

- Describing requirements for eligibility to receive compensation from the Environmental Compensation Corporation; and
- Outlining the limitations to the amount of claims paid out by the Environmental Compensation Corporation.

MOE is also proposing to register generators of industrial waste with the new regulation entitled "Registration for Generators of Hazardous Waste, Site-Specific Waste and Liquid Industrial Waste". The major highlights of this regulation will require that:

- Generators of the wastes defined by the regulations receive a generator number from MOE before disposing of waste;

EXHIBIT 7.2

SUMMARY OF THE MAJOR CHANGES PROPOSED FOR THE ONTARIO WAYBILL

Requirement	Current Requirements	Proposed Requirements	Change
1) Materials Waybilled	o Liquid industrial waste o Does not include recycled material	o Liquid industrial, site-specific and hazardous wastes o Does not include recycled material	o Adds solids and provides for more detailed definitions
2) Waybill form and distribution	o 5 copies: one retained by generator, carrier and receiver; one copy sent by generator and receiver to MOE	o 6 copies; extra copy to be sent by receiver to generator	o Closes the control loop
3) Retention of Waybill	o By generator, carrier, and receiver for one year	o By generator, carrier and receiver for two years	o Increased by one year
4) Waste Classification	o 21 broad categories, evolved over time	o Specific definitions based on U.N. classifications	
5) Waste Transfer	o Only to MOE certified carrier or receiver	o Only to MOE certified carrier or receiver	o No change
6) Generator Identification	o Not covered	o Carrier must have generator number before accepting load	o Additional requirement
7) Refusal of Receiver to Accept Waste	o Not covered	o Waste returned to generator for safe keeping while alternative arranged	o Additional requirement

- o Generators will not dispose of wastes prior to having a waste identification number for each waste stream being disposed of;
- o Generators must notify MOE of any change in the waste streams being transported from their facility;
- o The generator ensures that the carrier transporting the waste has a current certificate of approval for the waste being hauled;
- o The generator completes the appropriate portions of the waybill before offering the wastes for transport to the carrier;
- o The generator ensures that the wastes are adequately packaged and labelled;
- o The generator has available, in writing, an emergency management procedure for the waste, and this will be provided to the carrier of the waste; and
- o If the waste is refused by the intended disposal site, the generator must take back the waste for safe storage until an alternate disposal site is found.

The complete text of the proposed regulation is contained in Appendix G.

These regulations are designed to make the 'cradle to grave' management of wastes within the province more complete and rigorous. They complement the proposed revisions to Regulation 313 discussed earlier and form an integral part of MOE's "Blueprint for Waste Management", discussed below.

The "Blueprint for Waste Management" is a discussion paper to be released by MOE in the summer of 1983. The paper outlines an approach to all facets of waste management for the province. The significant points of the discussion paper, from the perspective of transportation of special wastes in the province, are:[4]

- o Proposed changes to the waybill system, discussed earlier;

- o Proposed registration of generators, discussed above;
- o Proposed definitions of wastes, discussed below, and
- o Considerations with regard to equipment, drivers, and performance guarantees, discussed below.

With respect to the definition of wastes, MOE has issued a report entitled "An Interim Guideline for the Interpretation of the Hazardous Waste Definition (Regulation 309)", March 1983. In this paper two broad categories of waste are defined: hazardous waste and site-specific waste.

The hazardous waste classification; liquid, sludge, or solid - consists of several specific subgroupings of waste, comprised of:

- o Hazardous Industrial Waste;
- o Acute Hazardous Waste;
- o Hazardous Waste Chemical;
- o Severely Toxic Waste;
- o Ignitable Waste;
- o Corrosive Waste;
- o Reactive Waste; and
- o Pathological Waste.

---

4. At the time of writing the Blueprint for Waste Management, MOE was not available. The description presented here is based on discussions with R. Gotts, Director Waste Management Branch and B. Boyko, Assistant Director and Manager Industrial Waste Policy Section, MOE, April 29, 1983.

All of these subclassifications of hazardous waste are defined in the report, either specifically by chemical composition or by manufacturing process employed. All of the wastes designated here are identified using the U.N. classification system.

Site-specific wastes are defined as either:

- o Site-specific industrial wastes, or
- o Leachate sensitive wastes.

Site-specific wastes are wastes that are likely to leach toxic constituents into the ground water - but are not identified as being one of the constituents of hazardous wastes. As part of the report on definitions, MOE has identified 20 solid wastes that would be considered site-specific, by manufacturing process.

Leachate sensitive wastes are not specifically defined in terms of the waste -but are defined in terms of the leachate which results from the waste. The criteria are detailed in the MOE report.

From a transportation perspective, the expanded and refined waste definitions are significant for a number of reasons, including:

- o The addition of solid wastes to the waybill system will require that generators be able to identify and physically separate solid wastes requiring waybilling. It is likely that the carriers will participate in this process by providing special containers;

- o The identification of site-specific solid wastes requires that the waste be disposed of at a certified landfill site which has the required hydrological characteristics. This may cause the transportation patterns for these wastes to shift; and

- o The increasing complexity of the definitions of wastes means that the carrier is more than ever dependent upon the generator to accurately identify the wastes being transported.

The Blueprint for Waste Management will also contain guidelines with respect to performance of carriers involved in the movement of wastes under the new definitions. MOE has developed these performance criteria in consultation with the Ontario Liquid Waste Carriers' Association, which represents the majority of the current liquid industrial waste carriers. The performance guidelines will cover the following areas:

- o Equipment specifications, which will be the regulations adopted under the federal Transportation of Dangerous Goods Act;
- o Placarding requirements, similar to those required under the federal Transportation of Dangerous Goods Act; however, there may be additional requirements;
- o Driver training requirements, which have not yet been outlined; and
- o 'Performance bonds' to be posted by the carriers at the time they apply for a certificate of authority to operate. The 'fund' so provided would be available to MOE to use to fund any cleanups required through improper or illegal disposal of wastes.

Since the Blueprint is to be a comprehensive approach to waste management, there will obviously be many more areas covered. However, the above points are those that are expected to have the greatest impact upon the transportation of special wastes to a facility operated by the OWMC.

7.6 MUNICIPAL LEGISLATION

Currently there are no significant pieces of municipal legislation that affect the movement of special waste within Ontario.

However, the goal of Ontario municipalities is to gain the authority to designate dangerous goods' truck routes through municipalities. While municipalities can, to a certain extent, control truck routes through load limitations and through noise controls, they cannot at this time restrict the movement of vehicles transporting dangerous goods.

In the recently published "Report of the Ontario Commission on Truck Safety" one of the recommendations is that:

> Municipalities should be given the authority to regulate both the times and routes for trucks and for the transportation of dangerous goods within their jurisdiction, except for provincial highways, which should remain the responsibility of the Ontario Minister of Transportation and Communications.

If this recommendation is enacted and municipalities exercised their authority, it is likely that special wastes would be allowed to move only on designated routes and perhaps only at certain times of the day. This would have significant impact on the transportation system, in that transportation costs will likely increase due to increased travel, and loss of flexibility for scheduling.

8.0 CONCLUSION

In a preliminary report such as this, there are very few conclusions that emerge from the research. The few conclusions that can be drawn are discussed here.

8.1 TRANSPORTATION MODE

Currently, wastes are transported almost exclusively by truck. Based upon current transportation charges and the methods of calculating these charges, the truck mode is likely to remain the preferred mode for special waste transportation.

Rail transportation may become more cost competitive in the future, particularly for movements from transfer stations to the treatment facility. The cost competitiveness of rail can be improved if during the site seiection process factors favourable to rail transport, such as proximity of main rail lines and the sites of the transfer stations and treatment facility are considered.

8.2 FOR-HIRE TRUCK COSTS

The cost competitives of rail is also dependent upon how for-hire truck costs are calculated. The current practice of not charging for backhaul is highly dependent upon the relatively short haul distances. In order for carriers to remain profitable, it is likely that they will adjust their method of computing prices to include backhaul costs, if haul distances increase significantly.

8.3 TRANSPORT DISTANCES

Carriers of liquid industrial waste maintain that generators are very price sensitive to the cost of waste disposal. As well, the generators rely, for the most part, upon the carrier to arrange for disposal as well as transportation. Thus the carriers try to minimize the generator's total disposal cost, comprised of transportation costs and disposal costs in order to compete for business. Transportation costs are minimized by reducing the distance travelled.

As a result, it is unlikely that special waste will be transported any further than necessary for disposal. Given the existing structure of the waste treatment industry in Ontario and existing legislation, special waste would only be transported from all parts of the province to a central disposal in the absence of closer alternative disposal sites, or if the total disposal costs were subsidized to make them competitive with the alternatives.

APPENDICES

Appendix A

OWMC

**Ontario
Waste Management
Corporation**

2 Bloor Street West
11th Floor
Toronto, Canada
M4W 3E2
(416) 923-2918

April 12, 1983

Dear Mr.

The Ontario Waste Management Corporation is a Crown Agency with responsibility for establishing a province-wide system for the safe treatment and disposal of liquid industrial waste and other hazardous waste. The Corporation is conducting studies that will be used in planning an integrated system of waste treatment and disposal facilities required to serve effectively the needs of Ontario's industrial community. We have retained the firm of Pilorusso Research Associates Inc. to prepare an analysis of transportation factors that must be considered when siting Waste Treatment Facilities, Collection and/or Transfer Station(s) and Waste Disposal Site(s) such as secure landfill.

We urgently require your assistance at this time. A representative from Pilorusso Research Associates will be calling you shortly to arrange an interview with an appropriate person within your company. We assure you that the sources of the information obtained during these discussions will be held in strictest confidence. We will not refer to your company by name.

Your cooperation at this time will help us to plan a waste management system that is well suited to the specific needs of all segments of industry in Ontario.

Sincerely,

D.A. Chant
Chairman and President

Ontario Trucking Association

March 28th, 1983

TO: Ontario Liquid Waste Carriers

FROM: Brian Crow, Executive Director, Ontario Liquid Waste Carriers Association

RE: Ontario Waste Management Corporation Transportation Study

Dear Member:

Please be aware that the Ontario Waste Management Corporation (OWMC) Chairman, Dr. Donald Chant, has assured me publicly that OWMC does not intend to participate in our segment of the industry. However, as part of its mandate, the OWMC must be able to demonstrate in the face of rigorous public scrutiny, that no element of the Ontario waste management system, including transportation, poses unreasonable risk for the people of Ontario. Transportation is now, and will continue to be, the most visible part of the waste management system, and therefore, the element of greatest potential concern to the public.

The OWMC is conducting a study of the waste transportation industry as part of the planning process for its treatment and disposal facilities. Pilorusso Research Associates Inc., a consulting firm specializing in transportation, has been hired by OWMC to gather information from carriers and prepare a report on all the transportation issues involved in Ontario's waste management system. Mr. Gerry Beech is my predecessor as Executive Director of OLWCA; Mr. Jack Shaw was OTA Director of Business Management Systems from 1980 to 1981. Felex Pilorusso will also be involved with the project. Felex has an extensive background in the trucking industry and is familiar with the issues that you face as carriers. The consultants know our industry well and we have confidence that they will prepare an objective report.

...../2

555 Dixon Road, Rexdale, Ontario M9W 1H8 Telephone (416) 249-7401
Affiliate Canadian Trucking Association

This study is an opportunity for our industry to demonstrate directly and publicly that we are responsible and professional in our businesses, that we provide a needed service at reasonable cost, and that we make a valuable contribution to Ontario's waste management system.

The consultants have assured us that all information they obtain will be held confidential. They will only submit "totals" of information received. If they cannot obtain accurate information from you they will have to estimate information. Then the OWMC will make decisions based on "estimates". Would it not be better to make decisions based on accurate information?

Your Executive urges you to co-operate fully with the consultants; the results of this undertaking hold significant potential benefits for your and our industry.

Yours truly,

Brian E. Crow
Executive Director
Ontario Liquid Waste
Carriers Association

P.S. Your Association will be working very closely with these consultants and will have a representative review the report that is submitted to the OWMC.

Ontario Trucking Association

March 28th, 1983

TO: Members of the Ontario Liquid Waste Carriers Association

FROM: Brian Crow, Executive Director

RE: Ontario Waste Management Corporation Transportation Study

Dear Member:

Please be aware that the Ontario Waste Management Corporation (OWMC) Chairman, Dr. Donald Chant, has assured me publicly that OWMC does not intend to participate in our segment of the industry. However, as part of its mandate, the OWMC must be able to demonstrate in the face of rigorous public scrutiny, that no element of the Ontario waste management system, including transportation, poses unreasonable risk for the people of Ontario. Transportation is now, and will continue to be, the most visible part of the waste management system, and therefore, the element of greatest potential concern to the public.

The OWMC is conducting a study of the waste transportation industry as part of the planning process for its treatment and disposal facilities. Pilorusso Research Associates Inc., a consulting firm specializing in transportation, has been hired by OWMC to gather information from carriers and prepare a report on all the transportation issues involved in Ontario's waste management system. While many members may not be familiar with the firm, most of you will know the consultants, Gerry Beech and Jack Shaw, who will be conducting interviews. Gerry is my predecessor as Executive Director of OLWCA; Jack was OTA Director of Business Management Systems from 1980 to 1981. Felex Pilorusso will also be involved with the project. Felex has an extensive background in the trucking industry and is familiar with the issues that you face as carriers. The consultants know our industry well and we have confidence that they will prepare an objective report.

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Your Executive urges you to co-operate fully with the consultants; the results of this undertaking hold significant potential benefits for your and our industry.

Yours truly,

Brian E. Crow
Executive Director
Ontario Liquid Waste
Carriers Association

555 Dixon Road, Rexdale, Ontario M9W 1H8 Telephone (416) 247-7131

Appendix B

QUESTIONNAIRE

For

TRANSPORTATION OF SPECIAL WASTES STUDY

Study being performed for:

ONTARIO WASTE MANAGEMENT CORPORATION

By

PILORUSSO RESEARCH ASSOCIATES INC.
Suite 603
347 Bay Street
Toronto, Ontario
M5H 2R7

QUESTIONNAIRE
TRANSPORTATION OF SPECIAL WASTES

Background

Transportation-related issues are critical to the process of choosing a site for the disposal of special wastes in Ontario. In order for the Ontario Waste Management Corporation to effectively deal with the public's safety and environmental concerns it should have a thorough understanding of the transportation issues. The firm of Pilorusso Research Associates Inc. has been awarded a contract to develop an overview of the transportation system required for the transportation of special wastes in Ontario. The overview will include:

- o a description of transportation modes,
- o formulation of a transportation model,
- o hazard analysis,
- o profile of existing waste transportation industry,
- o analysis of transportation costs, and
- o a background paper covering regulation, emergency response, and training.

To ensure that the data used in developing the overview are the best available and to allow firms transporting special wastes to have an input, this questionnaire has been prepared.

Scope of the Questionnaire

The questionnaire asks for information on:

- o company background,
- o fleet composition,
- o operational characteristics,
- o training programs,
- o accident experience, and
- o pricing of waste hauling and disposal services.

All data provided to Pilorusso Research Associates Inc. will be kept strictly confidential. Only industry totals and averages will appear in any reports or documents that are prepared from the data provided on the questionnaire.

Definition of Special Wastes

For the purpose of this questionnaire, special wastes are defined as those that generally fall into the following categories:

1. Organic Sludge and Still Bottoms
2. Solvents and Organic Solutions
3. Oils and Greases
4. Oil/Water Mixtures
5. Organic and Oily Residues
6. Heavy Metal Solutions and Residuals
7. Miscellaneous Chemicals and Products
8. Paint and Organic Residuals
9. Aqueous Solutions with Organics
10. Anion Complexes
11. Sludges and Inorganic Residuals
12. Pesticide and Herbicide Waste
13. P.C.B. Wastes
14. Cleanup Residuals

Any waste contained in the Ministry of the Environment Waste Classification Guide (Appendix I of this questionnaire) is considered a special waste.

Completetion of Questionnaires

In some cases a personal interview will be requested with Carriers to complete the questionnaire; in other cases telephone interviews will be carried out.

If you could take a few minutes to go through the questionnaire before the interview it would be helpful.

If you would prefer not to take the time for an interview but would like to contribute to the study, please complete and return the questionnaire to:

Pilorusso Research Associates Inc.
Suite 603
347 Bay Street
Toronto, Ontario
M5H 2R7

The persons responsible for carrying out the survey are Jack Shaw and Gerry Beech. If you have any questions or comments they can be reached at the above address or Jack can be reached on (416) 366-8796 and Gerry on (416) 366-8799.

Your cooperation is very much appreciated.

Company Name: _____

Address: _____

_____

Interviewee: _____

Position: _____

Phone: _____

A. COMPANY BACKGROUND

1. When was your company established? _____

2. Including yourself how many employees do you have?
   full-time_____ part-time_____

3. a) Do you transport material other than special waste? yes_____ no_____

   b) If yes, how much of the material that you move in a year is special waste?
   _____%

   c) Of the total number of truck trips that you make in a year, how many involve special waste? _____%

   d) Over the next five years, do you expect the amount of special waste in your business to:

   increase _____

   decrease _____

   remain about the same _____

   e) Other than special wastes, what materials do you transport?

   _____

   _____

   _____

4. a) **Please list any other companies, in which you have an ownership interest, that transport, transfer, store, treat or dispose of special wastes.**

_____

_____

_____

b) **What activities does each of these companies engage in?**

_____

_____

_____

* * * * *

B. FLEET DATA

1. Describe the composition of your fleet used for special waste. (Fill in the capacities of your tanks in the appropriate space in the left column; put the number of each in the appropriate spaces to the right.)

(a) Tanks

	Truck	Trailer	ASME Certified (yes or no)	Lined (specify lining material)
Stainless Steel				
____ gallons	____	____	____	____
____ gallons	____	____	____	____
____ gallons	____	____	____	____
____ gallons	____	____	____	____
Mild or Carbon Steel				
____ gallons	____	____	____	____
____ gallons	____	____	____	____
____ gallons	____	____	____	____
____ gallons	____	____	____	____
High Strength (HSLA) Steel				
____ gallons	____	____	____	____
____ gallons	____	____	____	____
____ gallons	____	____	____	____
____ gallons	____	____	____	____
Other Tanks (please specify e.g. aluminum, etc.)				
_____				
____ gallons	____	____	____	____
_____				
____ gallons	____	____	____	____
_____				
____ gallons	____	____	____	____

(b) Other Vehicles

	Straight Truck	Trailer
lugger vehicles	____	____
vans	____	____
flat beds	____	____
other _____ (please specify)	____	____

(c) Tractors (how many?) ____

2. In summary, your total number of vehicles used for special waste is:

____ tank trucks ____ tank trailers

____ tractors ____ other vehicles

3. Tank Vehicles

a) How many of your tanks are vacuum tanks?

straight trucks____ trailers____

b) What materials do you vacuum?

liquids____ sludges____ solids____

c) Do you use any MC 306 tanks (petroleum product tanks) in your waste business?

yes____ no____ how many?____

d) What product/products do you carry in MC 306 tanks?

_____

e) Are any of your tanks compartmentalized?

i Vacuum Tanks

yes____ no____ how many?____

ii Other Tanks

yes____ no____ how many?____

f) Please describe your compartmentalized tanks.

	Tank No. 1	Tank No. 2	Tank No. 3
Total capacity	_____	_____	_____
Number of compartments	_____	_____	_____

4. Lugger Vehicles

a) With respect to lugger vehicles, indicate the capacity of the lugger boxes used with this equipment and how many of each size you have.

Capacity	Number
_____	_____
_____	_____
_____	_____

b) If you use lugger boxes **only for storage** what are their capacities and how many of each size do you have?

Capacity	Number
_____	_____
_____	_____
_____	_____

5. a) When you use van trucks or trailers, what is the normal method of packaging wastes? (indicate typical sizes by weight or volume for each category)

drums	_____	_____	_____	_____
bags	_____	_____	_____	_____
boxes	_____	_____	_____	_____
other (please specify)	_____	_____	_____	_____

b) When you use flat bed trucks or trailers, what is the normal method of packaging wastes? (indicate typical sizes by weight or volume for each category)

drums	_____	_____	_____	_____
bags	_____	_____	_____	_____
boxes	_____	_____	_____	_____
other (please specify)	_____	_____	_____	_____

6. Please indicate the average age of your existing fleet and its expected service life. (Take the age of each vehicle, add them up and divide by the total number of vehicles)

	Average Age	Expected Service Life
Tank Truck Chassis	____	____
Tanks		
o Stainless Steel	____	____
o Mild or Carbon Steel	____	____
o High Strength (HSLA) Steel	____	____
o Other (please specify) _____	____	____
_____	____	____
Lugger Trucks	____	____
Van or Flat Bed Trucks	____	____
Flatbed Trailers	____	____
Van Trailers	____	____
Tractors	____	____
Other (please specify) _____	____	____

6. a) Do you or any of your affiliated companies operate a transfer station?

yes_____ no_____

b) If yes, how many storage tanks do you have and how much does each hold?

Size of Tank	How Many
_____	_____
_____	_____
_____	_____
_____	_____

c) Please list the wastes that you store in these tanks. (If possible, use the Ministry of the Environment Waste Classification Guide, Appendix I to describe the wastes.)

_____ _____

_____ _____

_____ _____

_____ _____

d) If you store wastes by other means than tanks, please describe the nature of your holding operation.

_____

_____

_____

8. With respect to developments in waste transportation equipment, in the next five years, what do you expect to see in your business?

More use of compartmentalized tanks yes_____ no_____

More tank trailers (as opposed to straight trucks) yes_____ no_____

Larger tanks yes_____ no_____

Other (please specify) _____

_____

_____

_____

* * * * *

C. OPERATIONAL CHARACTERISTICS

1. What is your geographic area of operation for special wastes?

_____

_____

_____

2. Distances Travelled

a) For the following equipment, while transporting special wastes, what is your estimate of mileage (kilometres) travelled for the calendar year 1982 while loaded and while empty?

	Loaded	Empty
Tank Trucks	____	____
Lugger Trucks	____	____
Van or Flat Bed Trucks	____	____
Tank Trailers	____	____
Van Trailers	____	____
Flat Bed Trailers	____	____
Other _____ (please specify)	____	____

b) Did your loaded and unloaded mileage (kilometres) for the years 1978-1981 differ from 1982? yes_____ no_____

c) If yes, please estimate what the difference was for each year.

i Mileage While Loaded

1981: _____% more _____ less _____ (check one) than 1982

1980: _____% more _____ less _____ (check one) than 1982

1979: _____% more _____ less _____ (check one) than 1982

1978: _____% more _____ less _____ (check one) than 1982

ii Mileage While Empty

1981: _____% more _____ less _____ (check one) than 1982

1980: _____% more _____ less _____ (check one) than 1982

1979: _____% more _____ less _____ (check one) than 1982

1978: _____% more _____ less _____ (check one) than 1982

d) For the calendar year 1982, please indicate the total number of times your vehicles were: loaded, and unloaded.

	Loaded	Unloaded
Tank Trucks	____	____
Lugger Trucks	____	____
Van or Flat Bed Trucks	____	____
Tank Trailers	____	____
Van Trailers	____	____
Flat Bed Trailers	____	____
Other_____ (please specify)	____	____

e) Did the total number of times your vehicles carrying special waste were loaded and unloaded in each year between 1978-1981 differ from 1982?

yes _____ no _____

f) If yes, please estimate the difference for each year.

i Vehicle Loadings

1981: _____% more _____ less _____ (check one) than 1982

1980: _____% more _____ less _____ (check one) than 1982

1979: _____% more _____ less _____ (check one) than 1982

1978: _____% more _____ less _____ (check one) than 1982

ii Vehicle Unloadings

1981: _____% more _____ less _____ (check one) than 1982

1980: _____% more _____ less _____ (check one) than 1982

1979: _____% more _____ less _____ (check one) than 1982

1978: _____% more _____ less _____ (check one) than 1982

3. a) Please list the wastes you regularly carry (do not list wastes you carry less than once a month), the size of an average pickup and the type of vehicle (as described in Section B, Question 1) you normally use. Please indicate waste type by referring to the M.O.E. Waste Classification Guide and putting in the appropriate number. (Please photocopy page if you need more room.)

Waste Name	M.O.E. Number	Size of an Average Pick Up	Vehicle Type Used

b) Please indicate the type of business from which you pick up each of the wastes listed in a):

Waste Name	Type of Business

c) Are any of the special wastes you listed in a) above compatible, in that you can mix them for transportation purposes? yes_____ no_____

d) If yes, please list the wastes that you can mix indicating what you mix them with.

Waste Type	Waste Type/Types it Can be Mixed With

D. TRAINING PROGRAMS

1. How many drivers do you employ? full-time_____ part-time_____

a) Do you currently have a formal training program for new drivers?

yes_____ no_____

b) Does this program involve a checkout of the driver on the truck?

yes_____ no_____

c) Does the program involve a description of the materials you transport and their hazards?

yes_____ no_____

d) Does the program involve specific response instructions for emergency situations, such as:

spill from overfilling	yes_____	no_____
spill from motor vehicle accident	yes_____	no_____
spill from storage tanks	yes_____	no_____
fire	yes_____	no_____
spill into waterway	yes_____	no_____
skin exposure/eye contact	yes_____	no_____

other (please specify) _____

_____

_____

_____

e) Do your drivers receive, or are they required to have, first aid training?

yes_____ no_____

3. How do you conduct the training program for new drivers?

within your company _____

by outside group (specify) _____

combination _____

_____

4. What safety equipment is carried on your vehicles: (check where appropriate)

gloves	____	goggles	____
rubber suits	____	filter masks (particulate)	____
ear plugs	____	filter masks (toxic)	____
helmets	____	fire extinguisher	____
safety glasses	____	breathing apparatus	____

other (specify) _____

_____

_____

_____

5. Are you aware of any program offering formal training that would be useful to your drivers? yes____ no____

If yes, please specify _____

_____

_____

_____

6. Are you aware of any regulations, either existing or proposed, relating to driver training? yes____ no____

If yes, please specify _____

_____

_____

_____

* * * * *

E. ACCIDENT EXPERIENCE

Note: For the purposes of this section, a "spill" is defined as the accidental discharge of an amount of waste sufficiently large to require clean up measures.

1. For the five calendar years 1978-1982, please state the number of accidents you have had in each of the following categories: (If you do not have data for 1978-1982, state the years your figures cover here: for the years_____)

   a) spills during loading _____

   b) spills during transit as a result of a motor vehicle accident _____

   c) reportable motor vehicle accidents that did not result in a spill _____

   d) spills during transit not as a result of a motor vehicle accident (e.g. equipment failure) _____

   e) spills during unloading _____

2. For **each** spill you have listed in question 1 above, please complete an accident description form in Appendix II. (Photocopy the form if you have had more than one spill.)

3. a) If you or your affiliated company operate a transfer station, have you had any spills in the calendar years 1978-1982?

   yes_____ no_____

   b) If yes, how many in each calendar year?

   1978_____ 1979_____ 1980_____ 1981_____ 1982_____

   c) For **each** spill experienced, please indicate the cause: (number the spills, and put appropriate number in appropriate space.)

   i tank rupture _____

   ii tank overflow _____

   iii tank valve failure _____

   iv tank seepage _____

   v tank knocked over _____

   vi other (please explain) _____

   _____

   _____

F. PRICING INFORMATION

1. a) Does the price you charge to your customers include the cost of disposal?

yes_____ no_____

b) If yes, approximately what percentage of your charges represent the subsequent cost of disposal? _____%

2. What are your prices for transportation services based on?

amount of time required to do the job _____

volume (i.e. gallons or litres) of material involved _____

amount (i.e. pounds or kilograms) of material involved _____

other (please specify) _____

---

3. a) If your price system is based on time charges, what is your typical charge for your equipment?

i

Tanks (specify truck or trailer and size)	Hourly Charge	Overtime Charge (evenings, weekends, etc.)

ii Other Vehicles (specify type)

b) For each of the waste types you have indicated you transport in Section C, Question 3, please indicate: the average loading time; the average trip length while loaded; the average unloading time; and the total charge (including disposal cost) to the generator.

Waste Type	Average Loading Time	Average Trip Length While Loaded	Average Un-Loading Time	Total Cost
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

* * * * *

APPENDIX I

MINISTRY OF THE ENVIRONMENT

WASTE CLASSIFICATION GUIDE

Class No.	Waste Description
101	**Acids**
	1. Sulfuric Acid
	2. Hydrochloric Acid
	3. Pickling Acid
	4. Pickle Liquor
	5. Stripping Solution
	6. Sulphonation Waste
	7. Low pH Waste
	8. Carbonate Waste
	9. Aluminum Chloride
	10. Acid Sludge
	11. Sulphate Sludge
	12. Acetic Acid
	13. Formic Acid
	14. Fatty Acids
	15. Phosphoric Acid
	16. Nitric Acid
102	**Alkalis**
	1. Caustic Solution
	2. Lye
	3. Soda
	4. Sodium Hydroxide
	5. Metal Cleaners
	6. Potash
	7. Ammonia
	8. Hydration Filtrate
	9. Bleaching Powder
	10. Aluminum Hydroxide
	11. Xanthelene (Alkali & Sulfur)
	12. Aluminux
	13. Lime Sludge
	14. Caustic Sludge
103	**Metal Finishing Wastes**
	1. Lead Chromate
	2. Zinc Chromate
	3. Chromic Acid
	4. Sodium Chromate
	5. Potassium Dichromate
	6. Chromium Sulphate
	7. Chromium Hydroxide
	8. Chromium Dioxide
	9. Chromium Sludge
	10. Zinc Plating Solution
	11. Zinc Hydroxide
	12. Zinc Sulphate
	13. Zinc Sludge
	14. Flux
	15. Nickel Plating Solution
	16. Nickel Sludge
	17. Brass Plating Solution
	18. Brass Pickle Acid
	19. Copper Plating Solution
104	**Cyanides**
	1. Sodium Cyanide
	2. Scrap Cyanide
	3. Stretford Liquor
	4. Cyanide Sludge
105	**Chemical Fertilizer Wastes**
106	**Phosphates**
	1. Bonderite
	2. Phosphate Sludge
	3. Phosphate Slurry

Class No.	Waste Description
201	**Oily Water**
	1. Oil and Water
	2. Diesel Fuel and Water
	3. Gasoline and Water
	4. Tanker Washings
	5. Spine Finish Waste
	6. Interceptor/Separator Waste
	7. Oil and VARSOL
	8. Coolants
	9. Slop Oil
	10. Tank Sludge
	11. Oil, Sand & Water
	12. Skimming Sludge
	13. Tar and Water
	14. Oily Sludge
	15. Pit Sludge
202	**Waste Oils**
	1. Used Oil
	2. Bunker Oil
	3. Crude Oil
	4. Kerosene
	5. Naphtha & Gas
	6. Asphalt
	7. Tars
203	**Organic Solvents**
	1. Acetone
	2. Methyl Ethyl Ketone (MEK)
	3. Alcohols
	4. Thinner
	5. Methyl Hydrate
	6. Ketones
	7. Fomaldehyde
	8. Cyclohexane
	9. Isopropyl Alcohol (IPA)
	10. Hexane
	11. Enamel Laquers
	12. Benzene
	13. Toluene
	14. Xylene
	15. Aromatic Hydrocarbons
	16. Styrene
	17. DOWTHERM
	18. Ethyl Benzene
	19. VARSOL
	20. Hexalene
204	**Chlorinated Solvents**
	1. Carbon Tetrachloride (CCl_4)
	2. Trichloroethylene
	3. Perchloroethylene
	4. Dry Cleaner's Solutions
205	**Plastic Resins**
	1. Vinyl
	2. Acrylic Resin
	3. Plasticizers
	4. Polymerstyrene
	5. Polyethylene
	6. Polystyrene
	7. Acrylonitrile (ACN)
	8. Nylon Salt Solution
	9. Malic Anhydride
	10. Styrene Acrylonitrile (ABS)
	11. Methyl Methacrylate
	12. Varnish
	13. Polyvinyl Chloride (PVC)
	14. Latex
	15. Isoprene
206	**Amines**
	1. Amide
	2. Toluene Diamine (DA)
	3. Trimethylamine (TMA)
	4. Triethylamine
	5. Urea
	6. Alcanolamines
	7. Oxazolidone
	8. MEA
	9. DEA
	10. FLEXONE
	11. MONEX
207	**Glycols**
	1. Polyether Glycol
	2. Propylene Glycol
	3. Polyglycol
	4. Polypropelene Glycol (VORANOL)
	5. Antifreeze

Class No.	Waste Description
208	**Phenols**
	1. TDI Residue
	2. Phenolic Oil
	3. Phenol and Water
209	**PCB's**
	1. PCB Liquid
	2. ASKAREL
	3. INERTEEN
	4. PYRDRAUL
301	**Pigments, Paints, Printing & Adhesives**
	1. Dye Solution
	2. Paint Solution
	3. Waste Ink
	4. Paint Sludge
	5. Wax and Water
	6. Rubber Cement
	7. Pigment Sludge/Slurry
302	**Pesticides**
	1. Pesticide Solutions
	2. VITAVAX
303	**Detergents, Cleaners & Soap**
	1. Laundry Wastes
304	**Pharmaceutical & Cosmetics**
190	**Other Inorganic** (to be stated)
290	**Other Organic** (to be stated)

Class No.	Waste Description
401	**Plant and Animal Wastes**
	1. Fat and Water
	2. Lignin
	3. Glue Wastes
	4. Grease and Water
	5. Molasses
	6. Tallow
	7. Concentrated Flavours
	8. Bacterial Sludge
	9. Grain and Water
	10. Mash
	11. Protenaceous Sludge
	12. Food Wastes
	13. Vegetable Oils
	14. Tannery Wastes
402	**Inert Sludges**
	1. Portland Cement
	2. Concrete Slurry
	3. Glazing Slurry
	4. Marble Sludge
	5. River Silt
	6. Carbon Black
	7. Metal Fines
	8. Clay Slurry
	9. Scrubber Water
	10. Scale
	11. Sand and Water
	12. Rock Wool
	13. Filter Backwash
	14. Silica
	15. Starch
	16. Titanium
	17. Plaster of Paris (Gypsum)
	18. Metalic Hydroxide Sludges (excluding chromium)

APPENDIX II

ACCIDENT DESCRIPTION FORM

1. Location of the accident: _____

_____

_____

_____

2. Date of the accident: _____

3. Type of vehicle involved: _____

4. Vehicle license number: _____

5. Substance spilled: _____

6. Quantity spilled: _____
(in gallons or litres, pounds or kilograms)

7. Did you clean up: _____ alone, or _____ with help.

8. If you had help in cleaning up, please describe the situation.

_____

_____

_____

_____

9. Describe the apparent cause of the accident.

_____

_____

_____

_____

10. On to what type of surface was the material spilled?

a) ground ____

b) waterway ____

c) concrete, paved or other surface where it could be contained ____

d) drain to a catchment basin ____

11. What was the severity of the accident

a) property damage ____

b) injury to the driver ____

c) other personal injury ____

d) death ____

* * * * *

Appendix C

THE ENVIRONMENTAL PROTECTION ACT, 1971

O. Reg. 926/76.
Transfers of Liquid Industrial Waste
Made November 10th, 1976
Filed November 18th, 1976

REGULATION MADE UNDER THE ENVIRONMENTAL PROTECTION ACT, 1971

TRANSFERS OF LIQUID INDUSTRIAL WASTE

1.—(1) In this Regulation,

(a) "hauler of waste" means a person who transports liquid industrial waste,

(b) "liquid industrial waste" means liquid waste that is a product of,

(i) an enterprise or activity involving industrial, manufacturing or commercial processes or operations,

(ii) research or an experimental enterprise or activity, or

(iii) an enterprise or activity to which subclause i would apply if the enterprise or activity were carried on for profit,

but does not include,

(iv) waste that is a product of a sewage system subject to the provisions of Part VII of the Act or a sewage works subject to *The Ontario Water Resources Act* or waste that is removed from a holding tank to which regulations made under clause *a* or *b* of subsection 1 of section 94 of the Act apply,

(v) waste discharged by its producer at the site where the waste is produced into municipal sanitary sewage works in accordance with applicable by-laws or into a sewage system as defined in Part VII of the Act that is being operated in accordance with the Act,

(vi) waste disposed of at a waste disposal site as defined in Part V of the Act operated by the producer of the waste and located on the site where the waste is produced, or

(vii) waste that is ashes, sand or recycled

(2) Liquid industrial waste is designated as a waste in addition to those wastes specified in clause *d* of section 28 of the Act. O. Reg. 926/76, s. 1.

2. Those facilities, equipment and operations of a producer of liquid industrial waste that are involved in the collection, handling or storage of liquid industrial waste are classified as a Class 1 waste management system. O. Reg. 926/76, s. 2.

3. Those facilities, equipment and operations of a hauler of waste that are involved in transporting liquid industrial waste are classified as a Class 2 waste management system. O. Reg. 926/76, s. 3.

4.—(1) No operator of a Class 1 waste management system shall permit liquid industrial waste to pass from his control except by transfer of the liquid industrial waste to a Class 2 waste management system for which a certificate of approval or a provisional certificate of approval has been issued.

(2) Where liquid industrial waste is transferred to a Class 2 waste management system from a Class 1 waste management system,

(a) the operator of the Class 2 waste management system shall provide to the operator of the Class 1 waste management system a numbered form obtained from the Ministry for the purpose, upon which form he has recorded his name and address and the registration number of the vehicle used; and

(b) the operator of the Class 1 waste management system shall obtain from the operator of the Class 2 waste management system the form referred to in clause *a* and shall,

(i) record on the form,

a. the name and address of the producer of the liquid industrial waste,

b. the description and amount of the liquid industrial waste being transferred, and

c. the date, time and place of the transfer,

(ii) sign the form, and

(iii) forward the completed form forthwith to the Ministry, retaining one copy thereof for a period of one year. O. Reg. 926/76, s. 4.

5. (1) No operator of a Class 2 waste management system shall permit liquid industrial waste to pass from his control except by transfer of the liquid industrial waste,

(a) to a waste management system or a waste disposal site for which a certificate of approval or a provisional certificate of approval has been issued, or

(b) to a sewage works under *The Ontario Water Resources Act* for which an approval under that Act has been issued and with the approval of the owner of such sewage works.

(2) Where liquid industrial waste is transferred from a Class 2 waste management system,

(a) the operator of the Class 2 waste management system shall,

(i) on a numbered form obtained from the Ministry for the purpose, record,

a. his name and address,

b. the registration number of the vehicle used,

c. a list of the numbers of all the forms provided pursuant to clause *a* of subsection 2 of section 4 in respect of the liquid industrial waste being transferred, and

d. if any of the liquid industrial waste being transferred was received from a Class 2 waste management system, a list of the numbers of all forms with which he was provided in respect of the receipt of the liquid industrial waste being transferred, and

(ii) if the transfer is to a sewage works under *The Ontario Water Resources Act*,

a. record on the same form,

1. the location of the sewage works,

2. the description and amount of the liquid industrial waste being transferred, and

3. the date, time and place of the transfer, and

b. sign the form and forward the completed form forthwith to the Ministry, retaining one copy thereof for a period of one year, or

(iii) if the transfer is to a waste management system or waste disposal site, provide the operator thereof with the form prepared as prescribed in subclause i of clause *a*, and

(b) the operator of a waste management system or waste disposal site to which the liquid industrial waste is transferred shall obtain the form prepared as prescribed in subclause i of clause *a* and shall,

(i) record on the form,

a. the location and the name of the operator of the waste management system or waste disposal site,

b. the number of the certificate of approval or provisional certificate of approval for the waste management system or waste disposal site,

c. the description and amount of the liquid industrial waste being transferred,

d. the date, time and place of the transfer of the liquid industrial waste, and

e. the date and method of disposal, the method of treatment or processing, or the destination of the liquid industrial waste, whichever is applicable,

(ii) sign the form, and

(iii) forward the completed form forthwith to the Ministry, retaining one copy thereof for a period of one year. O. Reg. 926/76, s. 5.

6.—(1) A Class 1 waste management system is exempt from section 31 of the Act in respect of the collection, handling and temporary storage of liquid industrial waste at the site where it is produced.

(2) The exemption in subsection 1 does not apply where the liquid industrial waste is a product of a waste management system or waste disposal site. O. Reg. 926/76, s. 6.

7. This Regulation comes into force on the 1st day of April, 1977. O. Reg. 926/76, s. 7.

INSTRUCTIONS

1. WHEN A LOAD IS PICKED UP FROM THE SOURCE:

   (a) THE CARRIER shall complete SECTION C, and an authorized person at the SOURCE shall complete SECTION A. The White and Green Copies are then left with the SOURCE.

   (b) THE SOURCE shall mail the White copy to the Ministry of the Environment at the address shown below, and retain the Green copy for one year.

---

2. WHEN A LOAD IS DELIVERED TO THE RECEIVER:

   (a) THE RECEIVER shall complete SECTION B. The Yellow and Blue copies are left with the RECEIVER. THE CARRIER may retain the Pink copy for his records.

   (b) THE RECEIVER shall send the Yellow copy to the Ministry of the Environment at the address shown below, and retain the Blue copy for one year.

---

3. WHEN A LOAD IS DELIVERED TO A SEWAGE WORKS:

   THE CARRIER shall complete SECTION B and mail the Yellow copy to the Ministry of the Environment at the address shown below. THE CARRIER shall retain the Blue copy for one year.

---

4. MAIL THE MINISTRY'S COPIES BY THE LAST DAY OF EACH WEEK.

   TO: Ontario Ministry of the Environment
   Waste Management Branch
   135 St. Clair Avenue West, 2nd floor
   Toronto, Ontario
   M4V 1P5

---

5. ** PENALTY **

   The maximum penalty for conviction on failing to comply with the regulation is $2,000. (Environmental Protection Act, 1971, Section 47)

Ministry of the Environment
Ontario

Transfers of Liquid Industrial Waste

Ontario Regulation 926/76

Important: See Instructions on Reverse

SOURCE (Complete Section A Only. Please Print)

A

Company Name

Waste Source Location — City/Town

Waste Description: Check One.

101 ☐ Acids	201 ☐ Oily Water	301 ☐ Pigments, Paint, Printing & Adhesives
102 ☐ Alkalis	202 ☐ Waste Oils	302 ☐ Pesticides
103 ☐ Metal Finishing Wastes	203 ☐ Organic Solvents	303 ☐ Detergents, Cleaners & Soaps
104 ☐ Cyanides	204 ☐ Chlorinated Solvents	304 ☐ Pharmaceutical & Cosmetics
105 ☐ Chemical Fertilizer Wastes	205 ☐ Plastic Resins	401 ☐ Plant & Animal Wastes
106 ☐ Phosphates	206 ☐ Amines	402 ☐ Inert Sludges
	207 ☐ Glycols	
	208 ☐ Phenols	
	209 ☐ PCB'S	

190 ☐ Other Inorganic (Specify) _____ 290 ☐ Other Organic (Specify) _____

Quantity ☐ Gallons ☐ Litres

Time Released | Day | Month | Year | Signature of Authorized Person

RECEIVER (Complete Section B Only. Please Print)

B

Company Name — MOE Certificate of Approval No. A

Site Location — City/Town

Transfer To: ☐ _____

DO NOT WRITE IN THIS AREA

By: ☐ Other (State Method) _____

Time Received | Day | Month | Year | Signature of Authorized Person

CARRIER (Complete Section C Only. Please Print)

C

Company Name — Waste Mgmt System Number A

Address — Number — Street — City/Town

Vehicle License Plate Number | Signature of Driver

MOE 1270 (8/78)

Appendix D

MINISTRY OF THE ENVIRONMENT

WASTE CLASSIFICATION GUIDE

Class No.	Waste Description
101	**Acids**
	1. Sulfuric Acid
	2. Hydrochloric Acid
	3. Pickling Acid
	4. Pickle Liquor
	5. Stripping Solution
	6. Sulphonation Waste
	7. Low pH Waste
	8. Carbonate Waste
	9. Aluminum Chloride
	10. Acid Sludge
	11. Sulphate Sludge
	12. Acetic Acid
	13. Formic Acid
	14. Fatty Acids
	15. Phosphoric Acid
	16. Nitric Acid
102	**Alkalis**
	1. Caustic Solution
	2. Lye
	3. Soda
	4. Sodium Hydroxide
	5. Metal Cleaners
	6. Potash
	7. Ammonia
	8. Hydration Filtrate
	9. Bleaching Powder
	10. Aluminum Hydroxide
	11. Xanthelene (Alkali & Sulfur)
	12. Aluminux
	13. Lime Sludge
	14. Caustic Sludge
103	**Metal Finishing Wastes**
	1. Lead Chromate
	2. Zinc Chromate
	3. Chromic Acid
	4. Sodium Chromate
	5. Potassium Dichromate
	6. Chromium Sulphate
	7. Chromium Hydroxide
	8. Chromium Dioxide
	9. Chromium Sludge
	10. Zinc Plating Solution
	11. Zinc Hydroxide
	12. Zinc Sulphate
	13. Zinc Sludge
	14. Flux
	15. Nickel Plating Solution
	16. Nickel Sludge
	17. Brass Plating Solution
	18. Brass Pickle Acid
	19. Copper Plating Solution
104	**Cyanides**
	1. Sodium Cyanide
	2. Scrap Cyanide
	3. Stretford Liquor
	4. Cyanide Sludge
105	**Chemical Fertilizer Wastes**
106	**Phosphates**
	1. Bonderite
	2. Phosphate Sludge
	3. Phosphate Slurry

Class No.	Waste Description
201	**Oily Water**
	1. Oil and Water
	2. Diesel Fuel and Water
	3. Gasoline and Water
	4. Tanker Washings
	5. Spine Finish Waste
	6. Interceptor/Separator Waste
	7. Oil and VARSOL
	8. Coolants
	9. Slop Oil
	10. Tank Sludge
	11. Oil, Sand & Water
	12. Skimming Sludge
	13. Tar and Water
	14. Oily Sludge
	15. Pit Sludge
202	**Waste Oils**
	1. Used Oil
	2. Bunker Oil
	3. Crude Oil
	4. Kerosene
	5. Naphtha & Gas
	6. Asphalt
	7. Tars
203	**Organic Solvents**
	1. Acetone
	2. Methyl Ethyl Ketone (MEK)
	3. Alcohols
	4. Thinner
	5. Methyl Hydrate
	6. Ketones
	7. Fomaldehyde
	8. Cyclohexane
	9. Isopropyl Alcohol (IPA)
	10. Hexane
	11. Enamel Laquers
	12. Benzene
	13. Toluene
	14. Xylene
	15. Aromatic Hydrocarbons
	16. Styrene
	17. DOWTHERM
	18. Ethyl Benzene
	19. VARSOL
	20. Hexalene
204	**Chlorinated Solvents**
	1. Carbon Tetrachloride (CCl_4)
	2. Trichloroethylene
	3. Perchloroethylene
	4. Dry Cleaner's Solutions
205	**Plastic Resins**
	1. Vinyl
	2. Acrylic Resin
	3. Plasticizers
	4. Polymerstyrene
	5. Polyethylene
	6. Polystyrene
	7. Acrylonitrile (ACN)
	8. Nylon Salt Solution
	9. Malic Anhydride
	10. Styrene Acrylonitrile (ABS)
	11. Methyl Methacrylate
	12. Varnish
	13. Polyvinyl Chloride (PVC)
	14. Latex
	15. Isoprene
206	**Amines**
	1. Amide
	2. Toluene Diamine (DA)
	3. Trimethylamine (TMA)
	4. Triethylamine
	5. Urea
	6. Alcanolamines
	7. Oxazolidone
	8. MEA
	9. DEA
	10. FLEXONE
	11. MONEX
207	**Glycols**
	1. Polyether Glycol
	2. Propylene Glycol
	3. Polyglycol
	4. Polypropelene Glycol (VORANOL)
	5. Antifreeze

Class No.	Waste Description
208	**Phenols**
	1. TDI Residue
	2. Phenolic Oil
	3. Phenol and Water
209	**PCB's**
	1. PCB Liquid
	2. ASKAREL
	3. INERTEEN
	4. PYRDRAUL
301	**Pigments, Paints, Printing & Adhesives**
	1. Dye Solution
	2. Paint Solution
	3. Waste Ink
	4. Paint Sludge
	5. Wax and Water
	6. Rubber Cement
	7. Pigment Sludge/Slurry
302	**Pesticides**
	1. Pesticide Solutions
	2. VITAVAX
303	**Detergents, Cleaners & Soap**
	1. Laundry Wastes
304	**Pharmaceutical & Cosmetics**
190	**Other Inorganic** (to be stated)
290	**Other Organic** (to be stated)

Class No.	Waste Description
401	**Plant and Animal Wastes**
	1. Fat and Water
	2. Lignin
	3. Glue Wastes
	4. Grease and Water
	5. Molasses
	6. Tallow
	7. Concentrated Flavours
	8. Bacterial Sludge
	9. Grain and Water
	10. Mash
	11. Protenaceous Sludge
	12. Food Wastes
	13. Vegetable Oils
	14. Tannery Wastes
402	**Inert Sludges**
	1. Portland Cement
	2. Concrete Slurry
	3. Glazing Slurry
	4. Marble Sludge
	5. River Silt
	6. Carbon Black
	7. Metal Fines
	8. Clay Slurry
	9. Scrubber Water
	10. Scale
	11. Sand and Water
	12. Rock Wool
	13. Filter Backwash
	14. Silica
	15. Starch
	16. Titanium
	17. Plaster of Paris (Gypsum)
	18. Metalic Hydroxide Sludges (excluding chromium)

Appendix E

Ministry of the Environment

Ontario

FOR MINISTRY USE ONLY
File A —

APPLICATION FOR A CERTIFICATE OF APPROVAL FOR A WASTE MANAGEMENT SYSTEM

IMPORTANT NOTE: This form must be submitted through the Regional Office

See back of form for instructions for completing this form.

1. Owner (Applicant)	Under the Environmental Protection Act and the Regulations, this application is made by:—	.....(Name) .....(Address) .... Telephone No.....
2. Type of system	For the Reissue / Issue of a Certificate of Approval for a	.....System
3. Municipalities and agencies served	Serving:-	....
IF APPLICATION IS FOR REISSUE, COMPLETE SECTIONS 4 AND 5 (A OR B)		
4. Previous certificate details	Certificate / Provisional Certificate of Approval:— for this system was issued on:—	No. ....197.....
5. Changes in system.	(A) The following changes in use, operation or ownership (have occurred since the date of the original application) OR (are proposed):—	....
	(B) No change in the use, operation or ownership of the system has occurred since the date of the original application.	☐
IF APPLICATION IS FOR ISSUE, COMPLETE SECTIONS 6, 7, 8 AND 9		
6. Waste disposal sites forming part of the system	The system includes:— Applications for Approval attached:— Certificates of Approval previously issued Nos.	.....Waste Disposal Sites ☐ Number..... .....
7. Other facilities	Other facilities forming part of this system include:—	.... Continued on attached sheet
8. Operator	The facilities described in Item 7 will be operated in conformity with the Environmental Protection Act by:—	.....(Name) .....(Address) ....
9. Additional information	The required supporting information to this application is attached.	☐

Dated this.....day of.....19.....

.....

Signature of Applicant

MOE 14304 9/73

Appendix F

PROPOSED AMENDED REGULATION 313 (Formerly 926/76)

UNDER THE ENVIRONMENTAL PROTECTION ACT, 1971

TRANSFER OF LIQUID INDUSTRIAL WASTE, SITE-SPECIFIC WASTE AND HAZARDOUS WASTE

---

1. (1) In this regulation,

(a) "Carrier" means any person or corporation, who, by virtue of ownership, management, control or operation is engaged in the transportation of liquid industrial waste, site-specific waste, or hazardous waste;

(b) "Director" means the Director of the Waste Management Branch of the Ministry;

(c) "Generator" means any person or corporation, by site, who, by virtue of ownership, management, operation or control, causes or allows to cause the creation or storage of liquid industrial waste, site-specific waste, or hazardous waste;

(d) "Hazardous waste" (see definition under separate cover);

(e) "Site-Specific waste" (see definition under separate cover);

(f) "Waybill" means Ministry form No. _____ in six parts as provided by the Ministry, including an original copy in white and five copies coloured, in sequence, green, yellow, pink, blue and brown, all of which are marked respectively, "Ministry's copy" No. 1, "Generator's copy" No. 2, "Ministry's copy" No. 3, "Carrier's copy" No. 4, "Receiver's copy" No. 5 and "Generator's copy" No. 6;

(g) "Liquid industrial waste" means waste that results from industrial processes or manufacturing or commercial operations, and is transported in a tank or other container for treatment, storage or disposal, and the waste has a slump more than 150 mm. (6 inches) when tested by the slump test method as prescribed in Appendix 1;

but does not include,

i) waste from the operation of a sewage system subject to the provisions of Part VII of the Act or the operation of a holding tank to which regulations made under clause (a) or (b) of subsection 3 of Section 136 of the Act apply;

ii) waste from the operation of a sewage works subject to the Ontario Water Resources Act where the principal wastes entering the works are from human origin;

iii) waste that is generated or removed for treatment, storage or disposal in an amount less than 25 litres per month by a generator;

iv) waste directly discharged by its generator from the site where the waste is generated into municipal sanitary sewage works in accordance with applicable by-laws or into a sewage system, as defined in Part VII of the Act, that is being operated in accordance with the Act;

(v) "recycled waste" as defined by section XX of Regulation XX;

(vi) waste from food processing operations, including food packing, food preserving, winery, cheese making;

(vii) "inert liquid waste" as defined in section XX of Regulation XX;

(viii) drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil or natural gas;

(ix) "processed organic waste" as defined in Ontario Regulation 309.

(h) "Receiver" means any person or corporation, who by virtue of ownership, management, control or operation is engaged in the receiving of liquid industrial waste, site-specific waste, or hazardous waste;

(i) A "site", as referred to in Section 1(1)(c), means the same geographically contiguous property or properties owned by the generator which may be divided by public or private right-of-way, provided such right-of-way is controlled by the generator and to which the public does not have access.

(2) Liquid industrial waste, site-specific waste and hazardous waste are designated as wastes in addition to those wastes specified in clause (d) of section 24 of the Act.

2. No generator shall permit liquid industrial waste, site-specific waste or hazardous waste to pass from his control or to leave the site where it is produced or stored except by transfer of the waste to a carrier operating under a current certificate of approval or provisional certificate of approval issued by the Ministry.

3. Where liquid industrial waste, site-specific waste or hazardous waste is transferred to a carrier from a generator,

   (1) The carrier shall, for each truckload or less to be transferred, complete section B (Carrier) of an intact waybill and give the intact waybill , at the time of the transfer, to the generator;

   (2) The generator, for each truckload or less to be transferred, shall obtain from the carrier an intact waybill completed as required by subsection (1), and shall;

      (a) at the time of the transfer, complete section A (generator) of the intact waybill,

      (b) remove the white copy of the waybill (Ministry's copy No. 1) and forward it within three working days of the transfer to the Director,

      (c) remove the green copy of the waybill (generator's copy No. 2) and retain it for a period of 2 years,

      (d) return the remaining four copies of the waybill to the carrier at the time of the transfer.

      (e) retain the brown copy of the waybill (Generator's copy No. 6) for a period of two years when it is returned from the receiver in accordance with section 6 (5).

4. (1) No carrier shall permit liquid industrial waste, site-specific waste or hazardous waste to pass from his control except by transfer of the waste to:

      (a) a receiver to whom a certificate of approval or a provisional certificate of approval for that type of waste has been issued by the Ministry; or

      (b) a receiver to whom a special receiver number has been issued by the Ministry; or

      (c) a sewage works under the Ontario Water Resources Act for which an approval under the Act has been issued and with the approval of the owner of such sewage works.

5. Where a transfer of liquid industrial waste, site-specific waste or hazardous waste takes place pursuant to section 4, the carrier shall give the receiver at the time of the transfer the remaining four parts of the waybill completed in accordance with section 3 for that load of waste.

6. Where a transfer of liquid industrial waste, site-specific waste or hazardous waste takes place pursuant to section 4, the receiver shall obtain from the carrier at the time of the transfer the remaining four parts of the waybill completed in accordance with section 3 for that load of waste and shall,

(1) at the time of transfer, complete section C (Receiver) of the remaining four parts of the waybill,

(2) remove the yellow copy of the waybill (Ministry's copy No. 3) and forward it within three working days of the transfer to the Director,

(3) return the pink copy of the waybill (Carrier's copy No. 4) to the carrier at the time of the transfer,

(4) retain the blue copy of the waybill (Receiver's copy No. 5) for a period of two years,

(5) forward the brown copy of the waybill (Generator's copy No. 6) to the generator within three working days of the transfer.

7. Where the receiver of the waste returns the pink copy of the waybill (Carrier's copy No. 4) to the carrier pursuant to subsection (3) of Section 6, the carrier shall retain that copy for a period of two years.

8. No carrier shall accept a transfer of liquid industrial waste, site-specific waste or hazardous waste from a generator outside of Ontario for the purposes of transport to a receiver in Ontario unless the generator provides him with the generator's identification number issued by the Ministry, and complies with subsection 2 of section 3.

9. Where a carrier transfers liquid industrial waste, site-specific waste or hazardous waste to a receiver located outside the Province of Ontario,

(a) the carrier shall, at the time of transfer, provide the receiver with the remaining four parts of the waybill completed in accordance with section 3 for that load of waste;

(b) the carrier shall ensure that the receiver completes section C (Receiver) of the remaining four parts of the waybill, and retain the blue copy of the waybill (Receiver's copy No. 5) and returns the remaining three parts to the carrier; and

(c) the carrier shall distribute copies No. 3, 4 and 6 of the waybill in accordance with section 6.

10. (1) Where liquid industrial waste, site-specific waste or hazardous waste is refused for disposal by the intended receiver, the generator of such waste shall take back the waste for safe storage until a suitable alternative receiver has agreed to accept the waste.

(2) Where the generator takes back the waste under subsection (1), the generator shall act as a receiver and shall, at the time of transfer,

(a) indicate on the remaining four parts of the waybill that the waste was refused by the receiver,

(b) return the pink copy of the waybill (Carrier's copy No. 4) to the carrier,

(c) remove the yellow copy of the waybill (Ministry's copy No. 3) and forward it within three working days of the transfer to the Director, and

(d) retain the blue copy (Receiver's copy No. 5) and the brown copy (Generator's copy No. 6) of the waybill for a period of 2 years.

(3) Upon refusal of the waste, the intended receiver shall submit a "refusal report" to the Director within five working days, indicating the waybill number, the generator's identification number, the carrier's Waste Management System number and the reason for refusal.

11. (1) No carrier shall have in his possession liquid industrial waste, site-specific waste or hazardous waste unless he has in his possession and accompanying the waste, a waybill in respect of such waste completed in accordance with section 3.

(2) Subsection (1) does not apply where the waste is generated outside the Province of Ontario and is transported by a carrier through Ontario to a receiver outside the Province of Ontario, and the carrier has in his possession and accompanying the waste a waste manifest document equivalent to the waybill issued by an appropriate authority.

12. (1) A carrier shall obtain blank intact waybill forms from the nearest Regional or District office of the Ministry for his own use.

(2) No carrier shall give, sell or lend to another carrier any blank intact waybill form assigned to him by the Ministry.

(3) No carrier shall borrow or use blank intact waybill forms assigned to another carrier by the Ministry.

(4) Where a carrier ceases to operate as a carrier of liquid industrial waste, site-specific waste or hazardous waste in Ontario he shall immediately return to the Ministry all remaining unused intact waybill forms assigned to him.

13. (1) The intact waybill form shall remain the property of the Ministry at all times. The Director may at any time give written notice to a carrier requiring that all or any unused waybill forms assigned to that carrier be returned to the Ministry. Upon receiving such notice, the carrier shall immediately surrender all or any unused waybill forms in his possession to an official of the Ministry.

(2) A carrier shall return to the Ministry any void or spoiled waybill form, within three working days from the time the form is voided or spoiled.

14. (1) Where a carrier employs the service of a second carrier for the transportation of liquid industrial, site-specific waste or hazardous waste, the original carrier shall ensure that the second carrier also holds a current certificate of approval or provisional certificate of approval issued by the Ministry and, the name and the number of the certificate of approval or the provisional certificate of approval of the second carrier shall be used on the waybill form for the transaction.

(2) The second carrier shall use his own waybill form assigned to him by the Ministry for the purpose of subsection 1.

15. No carrier shall transfer liquid industrial waste, site-specific waste or hazardous waste from one vehicle to another vehicle unless such transfer is made at a facility to which a certificate of approval or provisional certificate of approval has been issued by the Ministry for the purpose.

16. The Director may exempt, from the provisions of this Regulation, any particular waste produced by a particular generator.

17. (1) A generator is exempt from section 27 of the Act in respect of the collection, handling and temporary storage of liquid industrial waste, site-specific waste or hazardous waste at the site where it is produced.

(2) The exemption in subsection 1 does not apply where the waste is a product of a waste carrier or a waste receiver.

Appendix G

PROPOSED REGULATION XXX

UNDER THE ENVIRONMENTAL PROTECTION ACT, 1971

REGISTRATION FOR GENERATORS OF HAZARDOUS WASTE, SITE-SPECIFIC WASTE AND LIQUID INDUSTRIAL WASTE

---

1. (1) In this Regulation,

(a) "Generator" means any person or corporation, by site, who, by virtue of ownership, management, operation or control, causes or allows to cause the creation or storage of liquid industrial waste, site-specific waste or hazardous waste.

(b) "Carrier" means any person or corporation, who, by virtue of ownership, management, control or operation is engaged in the transportation of liquid industrial waste, site-specific waste or hazardous waste;

(c) "Receiver" means any person or corporation, who by virtue or ownership, management, control or operation is engaged in the receiving of liquid industrial waste, site-specific waste or hazardous waste;

(d) "Way-bill" means Ministry form No. _____ in six parts as provided by the Ministry, including an original copy in white and five copies coloured, in sequence, green, yellow, pink, blue and brown, all of which are marked respectively "Ministry's copy" No. 1, "Generator's copy" No. 2, "Ministry's copy" No. 3, "Carrier's copy" No. 4, "Receiver's copy" No. 5 and "Generator's copy" No. 6;

(e) "Liquid Industrial Waste" (See definition in Regulation 313)

(f) "Hazardous Waste" (See definition under separate cover)

(g) "Site-Specific Waste" (see definition under separate cover)

(h) A "site", as referred to in Section 1(1)(a), means the same geographically contiguous property or properties owned by the generator which may be divided by public or private right-of-way, provided such right-of-way is controlled by the generator and to which the public does not have access.

(2) Liquid industrial waste, site-specific waste and hazardous waste are designated as wastes in addition to those wastes specified in clause (d) of Section 24 of the Act.

2. (1) No generator shall

(a) dispose of liquid industrial waste, site-specific waste or hazardous waste; or

(b) permit liquid industrial waste, site-specific waste or hazardous waste to pass from his control or to leave the site where it is generated

unless he has first applied for and obtained a generator identification number issued by the Director of the Waste Management Branch of the Ministry.

(2) No generator shall

(a) dispose of liquid industrial waste, site-specific waste or hazardous waste; or

(b) permit liquid industrial waste, site-specific waste or hazardous waste to pass from his control or to leave the site where it is generated

unless he has first applied for and obtained a waste type number issued for each type of waste by the Director of the Waste Management Branch of the Ministry.

(3) (a) An applicant for a generator identification number and waste type numbers under subsections 1 and 2 shall be required to submit, by completing MOE form _____, the description, a range of physical and chemical characteristics of the waste and select the appropriate waste type number from the Ministry's listing for each type of waste as hauled and to carry out and report on any tests or analyses relating to these characteristics in a manner acceptable to the Director of the Waste Management Branch, and to provide such further information as the Director may require.

(b) After receiving the application form, and where in the opinion of the Director of the Waste Management Branch, the type of waste has been adequately and accurately described, and no further information is required, the Director may confirm the waste type number selected or assign a new appropriate waste type number.

(4) Subsections 1 and 2 do not apply where, in the opinion of the Regional Director of the Ministry, an emergency situation exists.

3. (1) Where a generator changes his product, manufacturing processes, equipment, raw materials, rates of production or methods of handling waste, that may significantly change the description, physical or chemical characteristics of the waste being hauled, the generator shall give notice in writing to the Director of the Waste Management Branch of the Ministry containing such information and particulars as may be required, prior to the waste being removed from the generator's site.

(2) Upon receiving the notice referred to in Subsection 1, the Director of the Waste Management Branch of the Ministry may require the generator to submit the description, physical and chemical characteristics of the waste, and to carry out and report on any tests or analyses relating to these characteristics of the waste in a manner acceptable to the Director, and to provide such further information as the Director may require.

(3) After receiving the information as prescribed in Subsection 2, the Director of the Waste Management Branch of the Ministry may confirm the waste type number selected or assign a new appropriate waste type number,

(4) Subsections 1,2, and 3 do not apply where the change to the waste type is of a temporary nature which may be a result of process malfunctions or emergency.

4. (1) No generator shall permit liquid industrial waste, site-specific waste or hazardous waste to pass from his control or to leave the site where it is generated except by transfer of the waste to a carrier operating under a current certificate of approval or provisional certificate of approval for such waste being hauled.

(2) Where liquid industrial waste, site-specific waste or hazardous waste is disposed of on the site where it is generated, the generator shall keep a record of the volume and types of waste being disposed. Such information shall be compatible with the registration data.

5. Where liquid industrial waste, site-specific waste or hazardous waste is transferred to a carrier, for each truckload or less to be transferred, the generator shall obtain from the carrier an intact way-bill form issued by the Ministry and,

(1) at the time of transfer, record his generator identification number and the waste type number for each type of waste being hauled, and complete and sign section A (Generator) of the way-bill form,

(2) distribute copies of the way-bill form in a manner as prescribed by Section _____ of Ontario Regulation 313, and

(3) ensure that the receiver signs and returns to him a copy of the way-bill form as an acknowledgement for the receipt of the waste in accordance with Section _____ of Regulation 313.

Where the generator does not receive a copy of the completed waybill form from the receiver within two weeks, he shall contact the receiver to satisfy himself that the waste was managed in an environmentally safe manner.

6. No generator shall transfer liquid industrial waste, site-specific waste or hazardous waste to a carrier unless he has first packaged and/or identified such wastes by marking or labeling the waste containers in accordance with the requirements as prescribed by the Dangerous Goods Transportation Act and regulations made under the Act.

7. This regulation also applies to

(1) a generator who is located outside the Province of Ontario and whose liquid industrial waste, site-specific waste or hazardous waste is consigned to a receiver located in the Province of Ontario, and

(2) a generator who is located within the Province of Ontario and whose liquid industrial waste, site-specific waste or hazardous waste is consigned to a receiver located outside the Province of Ontario.

8. No carrier shall remove or cause to remove liquid industrial waste, site-specific waste or hazardous waste from a generator's site unless the generator has first recorded his generator identification number and the waste type number for each type of waste being hauled on the intact way-bill form and fully completed and signed section A (generator) of the way-bill form.

9. (1) A generator of liquid industrial waste, site-specific waste or hazardous waste shall have readily available in writing an emergency management procedure for such waste, including names of persons to be contacted in case of an accidental spill or leakage, and such other information as the Director of Waste Management Branch may require.

(2) Such an emergency management procedure shall be provided by the generator to the operator of a carrier at the time of the transfer of the waste.

(3) Such an emergency management procedure shall be submitted to the Ministry with the application for the generator's identification number.

10. A generator is subject to this regulation unless he generates, for every month of a year, liquid industrial waste, site-specific waste or hazardous waste in an amount less than the small quantity allowed in the respective definitions of subsections 1(1),(e),(f), and (g).

(a) 25 litres of liquid industrial waste,

(b) one litre (or one kilogram) of hazardous waste listed in Schedule 2A,

(c) four litres (or five kilograms) of hazardous waste, listed in Schedule 1 or 2B, or

(d) five kilograms of site-specific waste.

The exemption in Subsection 1 does not apply where the waste is defined as hazardous by Schedule 3.

11. Where a generator believes that his waste is not hazardous because of plant-specific variations in raw materials, processes or other factors, the generator may seek to exempt his waste at a particular generating facility from the hazardous waste list by demonstrating to the satisfaction of the Director of the Waste Management Branch of the Ministry that the waste does not meet any of the criteria under which the waste was listed as a hazardous waste.

12. Where liquid industrial waste, site-specific waste or hazardous waste is refused for disposal by a receiver, the generator of such waste shall take back the waste for safe storage until a suitable alternative receiver has agreed to accept the waste.

SCHEDULE 1

A list of hazardous wastes with process descriptions, essentially same as wastes in class 9 of Federal Transportation of Dangerous Goods Act.

SCHEDULE 2

A list of hazardous substances, essentially same as those identified to be hazardous by EPA.

SCHEDULE 3

A list of hazardous substances being prepared by the Hazardous Contaminants office to be excluded from small quantity exemption.

APPENDIX H

TABLES

TABLE A.1

LOW VOLUME SCENARIO
ESTIMATED WASTE GENERATED BY GEOGRAPHIC AREA
(tonnes)
WASTE CATEGORY

Municipality	1	2	3	4	5	6	7	8	9[1]	10	11	12[1]	14[2]	Total
Hamilton	216	135	149	305	2,460	13,118	1,065	432		1,087	8,212		n/a	27,179
Toronto	1,374	990	599	1,649	2,145	19,000	998	2,952	215	155	906	13	n/a	30,996
Sault Ste. Marie		9	36	32	675	2,942	578	72		400	3,218		n/a	7,962
Mississauga	240	300	320	504	1,350	4,770	23	666		52	185	13	n/a	8,423
Kitchener	240	177	108	336	1,395	4,691	30	324	107	38	518		n/a	7,964
Windsor	840	93	301	310	2,385	2,147	173	414		14	148		n/a	6,825
Welland		51	18	89	375	4,611	105	72		117	1,091		n/a	6,529
Brampton	192	114	45	152	1,200	2,942	158	234	107	14	166		n/a	5,324
Sarnia	66	93	1,458	37	420	2,544	38	144	107	38	111	13	n/a	5,069
St. Catharines	204	78	63	158	225	1,670	698	216		20	647		n/a	3,979
Oshawa	1,098	99	72	147	195	1,749	75	450		38	277		n/a	4,200
Aurora	66	57	221	152	90	2,624	45	234		14	55		n/a	3,558
Thunder Bay		9	9	21	15	477	1,215	144		7	37		n/a	1,934
London	36	72	212	152	165	1,988	68	252		32	203		n/a	3,180
Barrie	48	63	18	84	135	875	23	108			629		n/a	1,983
Oakville	456	36	167	68	105	1,193	23	216		14	37		n/a	2,315
Cornwall	12	36	212	21	45	477	428	90		7	18		n/a	1,346
Guelph	12	72	18	89	180	1,193	15	72		14	92		n/a	1,757
Ottawa	66	36	18	84	75	1,113	60	126		32	111		n/a	1,721
Simcoe			9	16	195	795	45			59	351		n/a	1,470
Kingston		30	113	32	165	795	8	72			277		n/a	1,492
Cochrane		9	9	5	30	80	630	54					n/a	817
Woodstock	78	42	36	74	30	954	8	180		7	74		n/a	1,483
Chatham	168	21	54	47	75	795	23	108		14	74		n/a	1,379
Kirkland Lake				16	195	557	23	18		20	148		n/a	977
Brantford	48	42	18	84	45	557	68	234			18		n/a	1,114
Brockville	12	15	108	53	30	557	15	54			37		n/a	881
Belleville	36	21	9	37	15	557	8	72		7	18		n/a	780
St. Thomas	180	36	27	53	15	318		90			18		n/a	737
Cobourg	264	30	9	74	30	318	30	54			37		n/a	846
Halton Hills	48	21	9	68	30	318		36			18		n/a	548
Stratford	36	15	18	53	15	239		90			55		n/a	521
North Bay		21	9	21	45	318		36					n/a	450
Peterborough		30		37	15	318	8	54		7	18		n/a	487
Sudbury		9	9	21	30	159	15	18		7	37		n/a	305
Grimsby		15		21	15	318	23	18					n/a	410
Hawkesbury				16	30	159	8			7	37		n/a	257
Huntsville		15		6	15		23	54			37		n/a	150
Lindsay	12	21		6	45			18			37		n/a	139
Owen Sound	24		9	16	15	159		18					n/a	241
Dunnville				6	15	80	8			14	18		n/a	141
Orangeville		9		16	15	80		54					n/a	174
Walkerton				6		80							n/a	86
Other - Northwest		9		6	60	80	495	126					n/a	776
Other - Southeast	24	21	18	21	105	159	8	90		14	462		n/a	922
Other - South Central	12	36		37	60	159		36			18		n/a	358
Other - Southwest		9		21	15	159		36					n/a	240
Other - Northeast & Central	12	15		16	15		23	72					n/a	153
Total	6,000	3,000	4,500	5,250	15,000	79,500	7,500	9,000	750	2,250	18,495	75		151,320

1. Only the major municipalities of generation are shown. Most municipalities generate these streams but in small quantities.
2. Special waste class 13, PCB's, is not included.

Note: Totals do not add due to rounding.
Municipalities include all communities outlined in Appendix G of the Waste Quantities Study.

TABLE A.2

MEDIUM VOLUME SCENARIO
ESTIMATED WASTE GENERATED BY GEOGRAPHIC AREA
(tonnes)
WASTE CATEGORY

Municipality	1	2	3	4	5	6	7	8	9[1]	10	11	12[1]	14[2]	Total
Hamilton	508	221	224	232	4,740	22,655	1,519	768		3,381	29,615		55	63,918
Toronto	3,229	1,617	904	1,256	4,133	32,815	1,423	5,248	229	483	3,268	234	276	55,115
Sault Ste. Marie		15	54	24	1,301	5,080	824	128		1,246	11,606			20,278
Mississauga	564	490	483	384	2,601	8,238	321	1,184		161	667	234	55	15,382
Kitchener	564	289	163	256	2688	8101	43	576	114	119	1,868		442	15,223
Windsor	1,974	152	456	236	4,595	3,707	246	736		42	534		36	12,714
Welland		83	27	68	723	7,963	150	128		364	3,935		18	13,459
Brampton	451	186	68	116	2,312	5,080	225	416	114	42	600		36	9,646
Sarnia	155	152	2,203	28	809	4,394	54	256	114	119	400	234	165	9,083
St. Catharines	479	127	95	120	434	2,883	995	544		63	2,335			8,075
Oshawa	2,580	162	109	112	376	3,021	107	800		119	1,000		36	8,422
Aurora	155	93	333	116	173	4,531	64	416		42	200		18	6,141
Thunder Bay		15	14	16	29	824	1,733	256		21	133			3,041
London	85	118	320	116	318	3,433	96	448		98	734		18	5,784
Barrie	113	103	27	64	260	1,510	32	192			2,068		18	4,387
Oakville	1,072	59	252	52	202	2,060	32	384		42	133		18	4,306
Cornwall	28	59	320	16	87	824	610	160		21	67		18	2,210
Guelph	28	118	27	68	347	2,060	21	128		42	334			3,173
Ottawa	155	59	27	64	145	1,922	86	224		98	400		18	3,198
Simcoe			14	12	376	1,373	64			182	1,267			3,288
Kingston		49	170	24	318	1,373	11	128			1,001			3,074
Cochrane		15	14	4	58	137	899	96						1,223
Woodstock	183	69	54	56	58	1,648	11	320		21	267			2,687
Chatham	395	34	82	36	145	1,373	32	192		42	267			2,598
Kirkland Lake				12	376	961	32	32		63	534			2,010
Brantford	113	69	27	64	87	961	96	416			67			1,900
Brockville	28	25	163	40	58	961	21	96			133			1,525
Belleville	85	34	14	28	29	961	11	128		21	67		18	1,396
St. Thomas	423	59	41	40	29	549		160			67			1,368
Cobourg	197	49	14	16	58	549	43	96			133			1,155
Halton Hills	113	34	14	52	58	549		64			67		18	911
Stratford	85	25	27	40	29	412		160			200			978
North Bay		34	14	16	87	549		64					55	819
Peterborough		49		28	29	549	11	96		21	67			850
Sudbury		15	14	16	58	275	22	32		21	133			586
Grimsby		25		16	29	549	33	32						684
Hawkesbury				12	58	275	11			21	133			510
Huntsville		25		4	29		33	96			133			320
Lindsay	28	34		4	87			32			133			318
Owen Sound	56		14	12	29	275		32						418
Dunnville				4	29	137	11			42	67			290
Orangeville		15		12	29	137		96						289
Walkerton				4		137								141
Other - Northwest		15		4	116	137	706	224						1,202
Other - Southeast	56	34	27	16	202	275	11	160		42	1,668			2,491
Other - South Central	28	59		28	116	275		64			67			637
Other - Southwest		15		16	29	275		64						399
Other - Northeast & Central	28	25		12	29		33	128						255
Total	14,100	4,900	6,800	4,000	28,900	137,300	10,700	16,000	800	7,000	66,700	1,400	1,400	300,000

1. Only the major municipalities of generation are shown. Most municipalities generate these streams but in small quantities.
2. Special waste class 13, PCB's, is not included.

Note: Totals do not add due to rounding.
Municipalities include all communities outlined in Appendix G of the Waste Quantities Study.

TABLE A.3

HIGH VOLUME SCENARIO
ESTIMATED WASTE GENERATED BY GEOGRAPHIC AREA
(tonnes)
WASTE CATEGORY

Municipality	1	2	3	4	5	6	7	8	9[1]	10	11	12[1]	14[2]	Total
Hamilton	846	369	376	389	7,905	38,165	2,528	1,282		4,444	49,195		90	105,589
Toronto	5,382	2,706	1,516	2,104	6,893	55,281	2,367	8,758	372	635	5,429	401	453	92,297
Sault Ste. Marie		25	91	40	2,169	8,558	1,371	214		1,638	19,279			33,385
Mississauga	940	820	809	643	4,338	13,878	534	1,976		212	1,108	401	90	25,749
Kitchener	940	484	274	429	4,483	13,647	71	961	186	156	3,102		727	25,460
Windsor	3,290	254	764	395	7,664	6,245	409	1,228		55	886		60	21,250
Welland		139	46	114	1,205	13,415	249	214		478	6,537		30	22,427
Brampton	752	312	114	194	3,856	8,558	374	694	186	55	997		53	16,145
Sarnia	259	254	3,694	47	1,350	7,402	89	427	186	156	665	401	271	15,201
St. Catharines	795	213	160	201	723	4,857	1,655	908		83	3,878			13,473
Oshawa	4,300	271	182	188	627	5,089	178	1,335		156	1,662		60	14,048
Aurora	259	156	559	194	289	7,633	107	694		55	332		30	10,308
Thunder Bay		25	23	27	48	1,388	2,884	427		28	222			5,072
London	141	197	536	194	530	5,783	160	748		129	1,219		30	9,667
Barrie	188	172	46	107	434	2,544	53	320			3,767		30	7,661
Oakville	1,786	98	422	87	337	3,470	53	641		55	222		30	7,201
Cornwall	47	98	536	27	145	1,388	1,015	267		28	111		30	3,692
Guelph	47	197	46	114	578	3,470	36	214		55	554			5,311
Ottawa	259	98	46	107	241	3,238	142	374		129	665		30	5,329
Simcoe			23	20	627	2,313	107			239	2,105			5,434
Kingston		82	285	40	530	2,313	18	214			1,662			5,144
Cochrane		25	23	7	96	231	1,495	160						2,037
Woodstock	306	115	91	94	96	2,776	18	534		28	443			4,501
Chatham	658	57	137	60	241	2,313	54	320		55	443			4,338
Kirkland Lake				20	627	1,619	54	53		83	886			3,342
Brantford	188	115	46	107	145	1,619	160	694			111			3,185
Brockville	47	41	274	67	96	1,619	36	160			222			2,562
Belleville	141	57	23	47	48	1,619	18	214		28	111		30	2,336
St. Thomas	705	98	68	67	48	925		267			111			2,289
Cobourg	325	82	23	27	96	925	71	160			222			1,931
Halton Hills	188	57	23	87	96	925		107			111		30	1,624
Stratford	141	41	46	67	48	694		267			333			1,637
North Bay		57	23	27	145	925		107					90	1,374
Peterborough		82		47	48	925	18	160		28	111			1,419
Sudbury		25	23	27	96	463	36	53		28	222			973
Grimsby		41		27	48	925	54	53						1,148
Hawkesbury				20	96	463	18			28	222			847
Huntsville		41		7	48		54	160			222			532
Lindsay	47	57		7	145			53			222			531
Owen Sound	94		23	21	48	463		53						702
Dunnville				7	48	231	18			55	111			470
Orangeville		25		21	48	231		160						485
Walkerton				7		231								238
Other - Northwest		25		7	193	231	1,175	374						2,005
Other - Southeast	94	57	46	28	337	463	18	267		55	2,770			4,135
Other - South Central	47	98		49	193	463		107			111			1,068
Other - Southwest		25		28	48	463		107						671
Other - Northeast & Central	47	41		21	48		54	214						425
Total	23,500	8,200	11,400	6,700	48,200	231,300	17,800	26,700	1,300	9,200	110,800	2,400	2,300	499,800

1. Only the major municipalities of generation are shown. Most municipalities generate these streams but in small quantities.
2. Special waste class 13, PCB's, is not included.

Note: Totals do not add due to rounding.
Municipalities include all communities outlined in Appendix G of the Waste Quantities Study.

TABLE A.4

COMPONENTS OF THE OWMC WASTE STREAMS AND THE MOE EQUIVALENT CLASSIFICATION

OWMC Waste Stream	UCD #'s	Volume (tonnes)	% Total	Physical State	MOE Class
1) Organic Sludge & Still Bottom	247	2,300	5.2	Liquid	290
	248	7,300	15.7	Liquid	290
	261	1,400	2.9	Solid	205
	252	1,000	2.1	Liquid	190/290
	523	3,500	7.3	Solid	---
	263	1,400	2.9	Solid	205
	529	100	0.2		---
	446	28,500	59.6	Liquid	290
	257	1,900	3.9	Liquid	208
		47,800			
2) Solvents & Organic Solutions	211	3,700	8.7	Liquid	204
	212	100	0.2	Liquid	204
	213	2,000	4.7	Liquid	204
	214	17,500	41.3	Liquid	203
	215	300	0.7	Liquid	203
	216	4,700	11.1	Liquid	203
	217	700	1.7	Liquid	203
	221	100	0.2	Liquid	290
	222	900	2.1	Liquid	290
	223	200	0.4	Liquid	290
	224	12,200	28.8	Liquid	206/207
		42,400			
3) Oils & Greases	281	46,600	100	Liquid	202
		46,600			
4) Oil Water/Mixtures	283	69,000	100	Liquid	201
		69,000			
5) Organic & Oily Residues	264	1,400	0.6	Solid	205
	282	29,800	13.4	Liquid	201
	284	10,400	4.7	Liquid	201
	285	6,900	3.1	Liquid	201
	286	5,000	2.2	Liquid	201
	288	169,200	75.9	Liquid	201
	289	100	0.04	Liquid	201
	447	100	0.04	Liquid	290
		222,900			

TABLE A.4 (continued)

COMPONENTS OF THE OWMC WASTE STREAMS AND THE MOE EQUIVALENT CLASSIFICATION

	OWMC Waste Stream	UCD #'s	Volume (tonnes)	% Total	Physical State	MOE Class
6)	Heavy Metal Solutions & Residuals	111	149,000	25.8	Liquid	101
		112	800	0.1	Liquid	101
		113	22,600	3.9	Liquid	101
		121	19,500	3.4	Liquid	102
		122	700	0.1	Liquid	102
		123	55,200	9.6	Liquid	103
		131	9,900	1.7	Liquid	103
		132	1,100	0.2	Liquid	103
		133	213,400	36.9	Liquid	101
		141	32,300	5.6	Liquid	190
		142	200	0.03	Liquid	190
		143	2,900	0.5	Liquid	190
		244	5,000	0.8	Liquid	190
		251	1,900	0.3	Liquid	190/290
		431	43,800	7.6	"(Sludge)	402
		433	9,200	1.6	"(Sludge)	402
		445	6,600	1.1	Liquid	402
		523	3,500	0.6	Liquid	---
			577,600			
7)	Miscellaneous Chemicals & Products	145	5,400	3.7	Liquid	19[illegible]
		152	132,100	91.2	Solid	190 (olid)
		243	1,700	1.2	Mixed	30[illegible]
		245	200	0.1	Mixed	29
		416	4,100	2.8	Liquid	30[illegible]
		513	1,200	0.8	Mixed	29[illegible]
			144,700			
8)	Paint & Organic Residuals	254	100	0.2	Mixed	301
		258	900	1.8	Liquid	202
		262	9,600	19.7	Liquid	205
		454	30,600	62.7	Liquid	301
		455	7,600	15.6	Liquid	301
			48,800			
9)	Aqueous Solutions with Organics	225	3,100	70.5	Liquids	290
		226	1,000	22.7	Liquids	290
		227	200	4.5	Liquids	290
		228	100	2.3	Liquids	190
			4,400			

TABLE A.4 (continued)

COMPONENTS OF THE OWMC WASTE STREAMS AND THE MOE EQUIVALENT CLASSIFICATION

OWMC Waste Stream	UCD #'s	Volume (tonnes)	% Total	Physical State	MOE Class
10) Anion Complexes	146	4,800	13.8	Liquid	104
	147	2,600	7.5	Liquid	190
	444	27,400	78.7	Liquid	104
		34,800			
11) Sludges & Inorganic Residuals	151	133,000	53.9	Solid	190 (Solid)
	165	2,000	0.8	Solid	---
	167	1,700	0.6	Solid	---
	417	1,100	0.4	Liquid	---
	441	51,700	21.0	Liquid	402
	443	1,500	0.6	Liquid	106
	518	55,500	22.5	Solid	---
	509	100	0.04	Solid	---
		246,600			
12) Pesticide & Herbicide Waste	241	600	25	Mixed	302
	532	1,800	75	Solid	---
		2,400			
13) PCB Wastes	242	200	100	Liquid (does not include containers)	209
		200			
14) Cleanup Residuals	512	3,100	56.4	Mixed	402
	521	100	1.8	Solid	---
	528	2,000	36.4	Solid	---
	531	300	5.5	Solid	---
		5,500			

SOURCE: Waste Quantities Study, Proctor and Redfern Ltd., August 1982, pp. 39-41, pp. 44-48

TABLE A.5

NUMBER OF SHIPMENTS BY WASTE STREAM AND MUNICIPALITY
LIQUIDS AND SLUDGES ONLY - LOW VOLUME SCENARIO
OWMC WASTE STREAM PER YEAR

Municipality	Transported to	Travel Time	1 TL	1 LTL	2 TL	2 LTL	3 TL	3 LTL	4 TL	4 LTL	5 TL	5 LTL	6 TL	6 LTL	7 TL	7 LTL	8 TL	8 LTL	9 TL	9 LTL	10 TL	10 LTL	11 TL	11 LTL	12 TL	12 LTL	13 TL	13 LTL	14 TL	14 LTL	Total
Hamilton	Treatment F	29 min.	1	22	2	10	1	15	7	17	49	132	237	603	n/a	n/a	3	49	0	0	1	116	33	89	0	0	0	0	0	0	1,387
Toronto N	"	46 min.	4	40	9	38	3	31	17	44	21	57	171	437	n/a	n/a	11	167	1	9	1	8	2	5	0	1	0	0	0	0	1,077
Toronto S	"	76 min.	4	40	9	38	3	31	17	44	21	57	171	437	n/a	n/a	11	167	1	9	1	8	2	5	0	1	0	0	0	0	1,077
*Sault Ste. Marie	"	605 min.	0	0	1	0	1	0	1	0	29	0	125	0	n/a	n/a	3	0	0	0	2	0	27	0	0	0	0	0	0	0	190
Mississauga	"	45 min.	1	24	5	23	3	33	10	26	27	72	86	220	n/a	n/a	4	75	0	0	0	5	1	2	0	1	0	0	0	0	618
Kitchener	"	29 min.	1	24	3	13	1	11	7	18	28	75	85	216	n/a	n/a	2	36	1	9	0	4	2	6	0	0	0	0	0	0	542
*Windsor	"	198 min.	36	0	4	0	13	0	13	0	100	0	91	0	n/a	n/a	17	0	0	0	0	1	6	0	0	0	0	0	0	0	281
Welland	"	92 min.	0	0	1	4	0	3	1	5	7	20	83	212	n/a	n/a	1	8	0	0	0	12	5	13	0	0	0	0	0	0	375
Brampton	"	48 min.	1	19	2	9	4	5	3	8	24	64	53	135	n/a	n/a	2	26	1	10	0	2	1	2	0	0	0	0	0	0	371
*Sarnia	"	152 min.	3	0	4	0	64	0	1	0	18	0	108	0	n/a	n/a	6	0	4	0	2	0	1	0	0	1	0	0	0	0	212
St. Catharines	"	58 min.	1	20	1	6	1	7	3	9	5	12	30	77	n/a	n/a	2	35	0	0	0	2	3	8	0	0	0	0	0	0	222
Oshawa	"	85 min.	7	110	2	8	1	7	3	8	4	10	32	81	n/a	n/a	3	51	0	0	0	4	1	3	0	0	0	0	0	0	335
Aurora	"	78 min.	0	7	1	4	2	23	3	8	2	5	48	121	n/a	n/a	2	20	0	0	0	2	0	1	0	0	0	0	0	0	249
*Thunder Bay	"	1208 min.	0	0	1	0	1	0	1	0	1	0	20	0	n/a	n/a	6	0	0	0	0	1	1	0	0	0	0	0	0	0	32
London	"	91 min.	0	4	1	5	2	22	3	8	4	9	36	92	n/a	n/a	2	29	0	0	0	3	1	2	0	0	0	0	0	0	223
*Barrie	"	99 min.	2	0	2	0	1	0	3	0	6	0	37	0	n/a	n/a	4	0	0	0	0	0	6	0	0	0	0	0	0	0	61
Oakville	"	34 min.	3	46	1	3	1	17	2	4	2	6	21	55	n/a	n/a	2	25	0	0	0	2	0	1	0	0	0	0	0	0	190
*Cornwall	"	338 min.	1	0	1	0	20	0	1	0	2	0	20	0	n/a	n/a	4	0	0	0	0	1	0	1	0	0	0	0	0	0	51
Guelph	"	18 min.	0	1	1	5	0	2	1	5	4	10	21	55	n/a	n/a	1	8	0	0	0	2	0	2	0	0	0	0	0	0	118
Ottawa	"	361 min.	0	0	1	0	0	0	2	0	2	0	20	0	n/a	n/a	1	0	0	0	0	0	0	0	0	0	0	0	0	0	26
Simcoe	"	77 min.	0	0	0	0	0	1	0	1	4	11	15	37	n/a	n/a	0	0	0	0	0	6	0	4	0	0	0	0	0	0	81
Kingston	"	224 min.	0	0	1	0	5	0	1	0	7	0	34	0	n/a	n/a	3	0	0	0	0	0	0	0	0	0	0	0	0	0	53
Woodstock	"	53 min.	0	9	1	3	1	4	1	4	1	2	17	44	n/a	n/a	1	21	0	0	0	1	0	2	0	0	0	0	0	0	112
Chatham	"	160 min.	1	0	0	0	0	0	1	0	2	0	14	0	n/a	n/a	1	0	0	0	0	0	1	0	0	0	0	0	0	0	20
Brantford	"	52 min.	1	5	1	3	0	3	1	5	1	3	10	26	n/a	n/a	2	26	0	0	0	0	0	1	0	0	0	0	0	0	88
*Brockville	"	279 min.	1	0	1	0	5	0	3	0	1	0	24	0	n/a	n/a	2	0	0	0	0	0	0	1	0	0	0	0	0	0	38
*Belleville	"	175 min.	2	0	1	0	1	0	1	0	1	0	24	0	n/a	n/a	3	0	0	0	0	1	0	1	0	0	0	0	0	0	35
*St. Thomas	"	98 min.	8	0	1	0	1	0	3	0	1	0	13	0	n/a	n/a	2	0	0	0	0	0	0	1	0	0	0	0	0	0	30
*Cobourg	"	128 min.	3	0	1	0	1	0	1	0	1	0	14	0	n/a	n/a	2	0	0	0	0	0	0	1	0	0	0	0	0	0	24
Halton Hills	"	56 min.	0	6	1	1	0	1	1	4	1	2	6	15	n/a	n/a	1	4	0	0	0	0	0	1	0	0	0	0	0	0	44
Stratford	"	69 min.	0	4	1	1	0	3	1	3	1	1	4	5	n/a	n/a	1	11	0	0	0	0	1	1	0	0	0	0	0	0	37
*North Bay	"	314 min.	0	0	1	0	1	0	1	0	2	0	14	0	n/a	n/a	1	0	0	0	0	0	0	0	0	0	0	0	0	0	20
*Peterborough	"	161 min.	0	0	1	0	0	0	1	0	1	0	14	0	n/a	n/a	2	0	0	0	0	1	1	0	0	0	0	0	0	0	21
*Sudbury	"	347 min.	0	0	1	0	1	0	1	0	1	0	7	0	n/a	n/a	1	0	0	0	0	1	1	0	0	0	0	0	0	0	14
Grimsby	"	40 min.	0	0	1	1	0	0	0	3	1	1	6	15	n/a	n/a	0	2	0	0	0	0	0	0	0	0	0	0	0	0	30
*Huntsville	"	209 min.	0	0	1	0	0	0	0	1	1	0	0	0	n/a	n/a	2	0	0	0	0	0	1	0	0	0	0	0	0	0	6
*Lindsay	"	146 min.	1	0	1	0	0	0	0	1	4	0	0	0	n/a	n/a	1	0	0	0	0	0	1	0	0	0	0	0	0	0	9
*Owen Sound	"	137 min.	1	0	0	0	1	0	1	0	1	0	7	0	n/a	n/a	1	0	0	0	0	0	0	0	0	0	0	0	0	0	12
Dunnville	"	68 min.	0	0	0	0	0	0	0	1	1	1	1	4	n/a	n/a	0	0	0	0	0	2	0	1	0	0	0	0	0	0	11
Orangeville	"	79 min.	0	0	0	1	0	0	0	3	1	1	1	4	n/a	n/a	1	5	0	0	0	0	0	0	0	0	0	0	0	0	17
*Walkerton	"	110 min.	0	0	0	0	0	0	0	1	0	0	0	4	n/a	n/a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
			83	381	67	176	139	219	117	231	390	551	1,720	2,895			114	765	8	37	7	185	102	153	0	4	0	0	0	0	8,353

*Full truck loads only

MOVEMENTS TO CONSOLIDATION POINTS
(volume = tonnes)
OWMC WASTE STREAM

Municipality	Consolidation Point	1 Vol.	1 #	2 Vol.	2 #	3 Vol.	3 #	4 Vol.	4 #	5 Vol.	5 #	6 Vol.	6 #	7 Vol.	7 #	8 Vol.	8 #	9 Vol.	9 #	10 Vol.	10 #	11 Vol.	11 #	12 Vol.	12 #	13 Vol.	13 #	14 Vol.	14 #	Total Trips
Ottawa	Cornwall	66	3	20	3	18	2	44	5	39	4	634	51			60	6	0		32	4	24	2	0		0		0		85
Hawkesbury	Cornwall	0		0		0		16	2	30	3	159				0		0		7	1	8	1	0		0		0		17
Total to Cornwall		66	3	20	3	18	2	60	7	69	7	793	61			60	6	0		39	5	32	3	0		0		0		102
Kirkland Lake	North Bay	0		0		0		16	1	197	8	557	22			18	1	0		20	1	33	1	0		0		0		34
Cochrane	North Bay	0	0	9	1	9	1	5	1	30	1	80	3			54	2	0		0		0		0		0		0		9
Total to North Bay		0	0	9	1	9	1	21	2	227	9	637	25			72	3	0		20	1	33	1	0		0		0		43
Chatham	Sarnia	143	17	21	3	54	2	24	3	39	4	453	36			89	12	0		14	1	0		0		0		0		
Total to Sarnia		143	17	21	3	54	2	24	3	39	4	453	36			89	12	0		14	1	0		0		0		0		78

CONSOLIDATION POINT TO TREATMENT FACILITY
NUMBER OF 'TRUCKLOADS'*
OWMC WASTE STREAM

Consolidation Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
Cornwall	5	1	1	2	5	55	0	2	0	2	1	0	0	0	74
North Bay	0	1	1	1	17	44	0	3	0	1	1	0	0	0	42
Sarnia	13	1	2	1	3	32	0	4	0	1	0	0	0	0	33

*Truckload = 25 tonnes

TABLE A.6

NUMBER OF SHIPMENTS BY WASTE STREAM AND MUNICIPALITY
LIQUIDS AND SLUDGES ONLY - MEDIUM VOLUME SCENARIO
OWMC WASTE STREAM

Municipality	Transported to	Travel Time	1 TL	1 LTL	2 TL	2 LTL	3 TL	3 LTL	4 TL	4 LTL	5 TL	5 LTL	6 TL	6 LTL	7 TL	7 LTL	8 TL	8 LTL	9 TL	9 LTL	10 TL	10 LTL	11 TL	11 LTL	12 TL	12 LTL	13 TL	13 LTL	14 TL	14 LTL	Total
Hamilton	Treatment F	29 min.	3	50	4	17	2	23	5	13	95	254	408	1,040	n/a	n/a	5	87	0	0	4	361	117	325	0	0	0	0	1	2	2,816
Toronto N	"	46 min.	10	160	14	63	4	47	13	34	41	110	295	754	n/a	n/a	19	298	1	10	1	26	7	18	0	4	0	0	1	4	1,934
Toronto S	"	76 min.	10	160	14	63	4	47	13	34	41	110	295	754	n/a	n/a	19	298	1	10	1	26	7	18	0	4	0	0	1	4	1,934
*Sault Ste. Marie	"	605 min.	0	0	1	0	2	0	1	0	55	0	216	0	n/a	n/a	5	0	0	0	7	0	99	0	0	0	0	0	1	0	387
Mississauga	"	43 min.	4	56	8	38	4	51	8	20	52	139	148	379	n/a	n/a	8	134	0	0	1	17	2	7	0	7	0	0	1	2	1,086
Kitchener	"	29 min.	4	56	5	22	1	17	5	14	54	144	146	372	n/a	n/a	4	65	1	10	0	13	7	20	0	0	0	0	4	12	976
*Windsor	"	198 min.	83	0	6	0	20	0	10	0	193	0	157	0	n/a	n/a	31	0	0	0	2	0	21	0	0	0	0	0	1	0	524
Welland	"	92 min.	0	0	1	7	0	4	1	4	14	38	143	366	n/a	n/a	1	14	0	0	1	39	16	43	0	0	0	0	0	1	693
Brampton	"	48 min.	3	44	3	14	6	7	2	6	47	124	91	233	n/a	n/a	3	47	1	11	0	5	2	7	0	0	0	0	0	2	658
*Sarnia	"	152 min.	7	0	6	0	98	0	1	0	34	0	187	0	n/a	n/a	11	0	4	0	5	0	4	0	10	0	0	0	4	0	371
St. Catharines	"	58 min.	3	47	2	10	1	10	2	7	9	23	52	133	n/a	n/a	4	62	0	0	0	7	9	26	0	0	0	0	0	0	407
Oshawa	"	85 min.	16	255	3	13	2	11	2	6	8	20	55	139	n/a	n/a	6	91	0	0	0	14	4	11	0	0	0	0	1	1	658
Aurora	"	78 min.	1	16	2	7	3	35	2	6	4	9	82	208	n/a	n/a	3	35	0	0	0	5	1	2	0	0	0	0	0	1	422
*Thunder Bay	"	1208 min.	0	0	1	0	1	0	1	0	1	0	35	0	n/a	n/a	11	0	0	0	1	0	1	0	0	0	0	0	0	0	52
London	"	91 min.	1	8	2	9	3	34	2	6	7	17	62	158	n/a	n/a	3	51	0	0	0	11	3	8	0	0	0	0	0	1	386
*Barrie	"	99 min.	5	0	4	0	1	0	2	0	11	0	64	0	n/a	n/a	8	0	0	0	0	0	19	0	0	0	0	0	1	0	115
Oakville	"	34 min.	7	106	1	5	2	26	1	3	4	11	37	95	n/a	n/a	3	44	0	0	0	5	1	1	0	0	0	0	0	1	353
*Cornwall	"	338 min.	1	0	2	0	14	0	1	0	4	0	35	0	n/a	n/a	7	0	0	0	1	0	1	0	0	0	0	0	1	0	67
Guelph	"	18 min.	0	3	2	9	0	4	1	4	7	19	37	95	n/a	n/a	1	14	0	0	0	5	1	4	0	0	0	0	0	0	206
*Ottawa	"	361 min.	1	0	1	0	1	0	3	0	3	0	35	0	n/a	n/a	2	0	0	0	0	0	2	0	0	0	0	0	0	0	48
Simcoe	"	77 min.	0	0	0	0	0	2	0	1	8	22	25	63	n/a	n/a	0	0	0	0	0	20	5	14	0	0	0	0	0	0	160
*Kingston	"	224 min.	0	0	2	0	8	0	1	0	13	0	58	0	n/a	n/a	5	0	0	0	0	0	8	0	0	0	0	0	0	0	95
Woodstock	"	53 min.	1	18	1	5	1	6	1	3	1	3	29	76	n/a	n/a	2	37	0	0	0	2	1	3	0	0	0	0	0	0	190
*Chatham	"	160 min.	2	0	1	0	1	0	1	0	3	0	25	0	n/a	n/a	1	0	0	0	0	0	1	0	0	0	0	0	0	0	35
Brantford	"	52 min.	2	11	1	5	0	4	1	4	2	5	17	44	n/a	n/a	3	47	0	0	0	0	0	1	0	0	0	0	0	0	147
*Brockville	"	279 min.	1	0	1	0	7	0	2	0	2	0	41	0	n/a	n/a	4	0	0	0	0	0	1	0	0	0	0	0	0	0	59
*Belleville	"	175 min.	4	0	1	0	1	0	1	0	1	0	41	0	n/a	n/a	5	0	0	0	1	0	1	0	0	0	0	0	1	0	57
*St. Thomas	"	98 min.	18	0	2	0	2	0	2	0	1	0	23	0	n/a	n/a	3	0	0	0	0	0	1	0	0	0	0	0	0	0	52
*Cobourg	"	128 min.	8	0	2	0	1	0	1	0	2	0	23	0	n/a	n/a	4	0	0	0	0	0	1	0	0	0	0	0	0	0	42
Halton Hills	"	56 min.	1	11	1	2	0	2	1	3	1	3	10	25	n/a	n/a	1	7	0	0	0	0	0	1	0	0	0	0	0	1	70
Stratford	"	69 min.	1	8	1	2	0	4	1	2	1	2	7	19	n/a	n/a	1	18	0	0	0	0	1	2	0	0	0	0	0	0	70
*North Bay	"	314 min.	0	0	1	0	1	0	1	0	4	0	23	0	n/a	n/a	2	0	0	0	0	0	0	0	0	0	0	0	1	0	33
*Peterborough	"	161 min.	0	0	2	0	0	0	1	0	1	0	23	0	n/a	n/a	4	0	0	0	1	0	1	0	0	0	0	0	0	0	33
*Sudbury	"	347 min.	0	0	1	0	1	0	1	0	2	0	11	0	n/a	n/a	1	0	0	0	1	0	1	0	0	0	0	0	0	0	19
Grimsby	"	40 min.	0	0	1	2	0	0	0	2	1	2	10	25	n/a	n/a	0	4	0	0	0	0	0	0	0	0	0	0	0	0	47
*Huntsville	"	209 min.	0	0	1	0	0	0	0	1	2	0	0	0	n/a	n/a	4	0	0	0	0	0	1	0	0	0	0	0	0	0	9
*Lindsay	"	146 min.	1	0	1	0	0	0	0	1	4	0	0	0	n/a	n/a	1	0	0	0	0	0	1	0	0	0	0	0	0	0	9
*Owen Sound	"	137 min.	2	0	0	0	1	0	1	0	1	0	11	0	n/a	n/a	1	0	0	0	0	0	0	0	0	0	0	0	0	0	17
Dunnville	"	68 min.	0	0	0	0	0	0	0	1	1	2	2	6	n/a	n/a	0	0	0	0	0	4	0	1	0	0	0	0	0	0	17
Orangeville	"	79 min.	0	0	0	2	0	0	0	2	1	2	2	6	n/a	n/a	1	8	0	0	0	0	0	0	0	0	0	0	0	0	24
*Walkerton	"	110 min.	0	0	0	0	0	0	0	1	0	0	6	0	n/a	n/a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
			200	1,009	102	295	193	334	92	178	736	1,059	2,967	4,990			197	1,361	8	41	27	560	348	512	10	15	0	0	19	32	15,285

*Full truck loads only

MOVEMENTS TO CONSOLIDATION POINTS
(volume = tonnes)
OWMC WASTE STREAM

Municipality	Consolidation Point	1 Vol.	1 #	2 Vol.	2 #	3 Vol.	3 #	4 Vol.	4 #	5 Vol.	5 #	6 Vol.	6 #	7 Vol.	7 #	8 Vol.	8 #	9 Vol.	9 #	10 Vol.	10 #	11 Vol.	11 #	12 Vol.	12 #	13 Vol.	13 #	14 Vol.	14 #	Total Trips
Ottawa	Cornwall	132	15	33	5	28	4	34	3	75	8	1,103	88			186	25	0	0	98	11	47	4	0		0		10	1	164
Hawkesbury	Cornwall	0	0	0	0	0	0	12	1	58	5	278	18			0		0	0	21	2	29	3	0		0		0		29
Total to Cornwall		132	15	33	5	28	4	46	4	133	13	1,381	106			186	25	0		119	13	76	7	0		0		10	1	193
Kirkland Lake	North Bay	0	0	0	0	0	0	12	1	376	15	971	39			32	1	0	0	66	2	117	3	0		0		0		63
Cochrane	North Bay	0	0	16	1	14	1	4	1	58	2	139	6			96	4	0	0	0	0	0		0		0		0		15
Total to North Bay		0	0	16	1	14	1	16	2	434	17	1,110	45			128	5			66	2	117	5							78
Chatham	Sarnia	335	39	19	3	65	9	19	2	75	8	788	63			159	22	0	0	44	5	31	3	0		0		0		152
Total to Sarnia		335	39	19	3	65	9	19	2	75	8	788	63			159	22	0		44	5	31	3							152

CONSOLIDATION POINTS TO TREATMENT FACILITY
NUMBER OF 'TRUCKLOADS'*
OWMC WASTE STREAM

Consolidation Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total Trips
Cornwall	5	1	1	2	3	55		7	0	5	3	0	0	1	83
North Bay	0	1	1	1	17	44		5	0	2	5	0	0	0	76
Sarnia	13	1	2	1	3	32		6	0	2	1	0	0	0	61

*Truckload = 25 tonnes

TABLE A.7

NUMBER OF SHIPMENTS BY WASTE STREAM AND MUNICIPALITY
LIQUIDS AND SLUDGES ONLY - HIGH VOLUME SCENARIO
OWMC WASTE STREAM

Municipality	Transported to	Travel Time	1 TL	1 LTL	2 TL	2 LTL	3 TL	3 LTL	4 TL	4 LTL	5 TL	5 LTL	6 TL	6 LTL	7 TL	7 LTL	8 TL	8 LTL	9 TL	9 LTL	10 TL	10 LTL	11 TL	11 LTL	12 TL	12 LTL	13 TL	13 LTL	14 TL	14 LTL	Total
Hamilton	Treatment F	29 min.	5	84	6	29	3	39	8	21	159	423	680	1,734	n/a	n/a	9	145	0	0	5	475	195	541	0	0	0	0	1	3	4,565
Toronto N	"	46 min.	17	266	23	105	7	79	21	56	69	184	492	1,256	n/a	n/a	32	497	1	17	1	34	11	30	0	6	0	0	2	6	3,212
Toronto S	"	76 min.	17	266	23	105	7	79	21	56	69	184	492	1,256	n/a	n/a	32	497	1	17	1	34	11	30	0	6	0	0	2	6	3,212
*Sault Ste. Marie	"	605 min.	0	0	1	0	4	0	2	0	91	0	360	0	n/a	n/a	9	0	0	0	9	0	164	0	4	0	0	0	2	0	646
Mississauga	"	45 min.	6	93	14	63	7	85	13	34	87	232	247	631	n/a	n/a	14	224	0	0	1	23	4	12	0	12	0	0	1	3	1,806
Kitchener	"	29 min.	6	93	8	37	2	29	9	23	90	240	243	620	n/a	n/a	7	109	1	17	0	17	12	34	0	0	0	0	7	20	1,624
*Windsor	"	198 min.	139	0	10	0	34	0	16	0	321	0	262	0	n/a	n/a	51	0	0	0	2	0	34	0	0	0	0	0	1	0	870
Welland	"	92 min.	0	0	2	11	0	6	2	6	24	64	239	610	n/a	n/a	2	24	0	0	1	51	26	72	0	0	0	0	0	2	1,142
Brampton	"	48 min.	5	74	5	24	1	12	3	10	78	206	152	389	n/a	n/a	5	79	1	18	0	6	4	11	0	0	0	0	0	3	1,086
*Sarnia	"	152 min.	11	0	10	0	163	0	2	0	56	0	311	0	n/a	n/a	18	0	7	0	7	0	6	0	16	0	0	0	6	0	613
St. Catharines	"	58 min.	5	79	4	16	1	17	4	11	15	39	87	221	n/a	n/a	7	103	0	0	0	9	15	43	0	0	0	0	0	0	676
Oshawa	"	85 min.	27	425	5	21	2	19	4	10	13	34	91	231	n/a	n/a	10	151	0	0	0	17	7	18	0	0	0	0	1	2	1,088
Aurora	"	78 min.	2	26	3	12	5	59	4	10	6	15	136	347	n/a	n/a	5	79	0	0	0	6	1	4	0	0	0	0	0	2	722
*Thunder Bay	"	1208 min.	0	0	1	0	1	0	1	0	2	0	58	0	n/a	n/a	18	0	0	0	1	0	2	0	0	0	0	0	0	0	84
London	"	91 min.	1	14	3	15	5	56	4	10	11	28	103	263	n/a	n/a	5	85	0	0	0	14	5	13	0	0	0	0	0	2	637
*Barrie	"	99 min.	8	0	7	0	2	0	4	0	18	0	107	0	n/a	n/a	13	0	0	0	0	0	32	0	0	0	0	0	1	0	192
Oakville	"	34 min.	11	177	2	8	4	44	2	5	7	18	62	158	n/a	n/a	5	73	0	0	0	6	1	2	0	0	0	0	0	2	587
*Cornwall	"	338 min.	2	0	4	0	24	0	1	0	6	0	58	0	n/a	n/a	11	0	0	0	1	0	1	0	0	0	0	0	1	0	109
Guelph	"	18 min.	0	5	3	15	0	6	2	6	12	31	62	158	n/a	n/a	2	24	0	0	0	6	2	6	0	0	0	0	0	0	340
*Ottawa	"	361 min.	2	0	2	0	2	0	5	0	5	0	58	0	n/a	n/a	3	0	0	0	0	0	3	0	0	0	0	0	0	0	80
Simcoe	"	77 min.	0	0	0	0	0	3	0	2	13	35	41	105	n/a	n/a	0	0	0	0	0	26	8	23	0	0	0	0	0	0	256
*Kingston	"	224 min.	0	0	3	0	13	0	2	0	22	0	97	0	n/a	n/a	9	0	0	0	0	0	14	0	0	0	0	0	0	0	160
Woodstock	"	53 min.	2	30	2	9	1	10	2	5	2	5	49	126	n/a	n/a	4	61	0	0	0	3	2	5	0	0	0	0	0	0	318
*Chatham	"	160 min.	3	0	1	0	1	0	1	0	5	0	41	0	n/a	n/a	2	0	0	0	0	0	2	0	0	0	0	0	0	0	56
Brantford	"	52 min.	4	19	2	9	0	6	2	6	3	8	29	74	n/a	n/a	5	79	0	0	0	0	0	2	0	0	0	0	0	0	248
*Brockville	"	279 min.	2	0	2	0	12	0	3	0	4	0	68	0	n/a	n/a	7	0	0	0	0	0	2	0	0	0	0	0	0	0	100
*Belleville	"	175 min.	6	0	2	0	1	0	2	0	2	0	68	0	n/a	n/a	9	0	0	0	1	0	1	0	0	0	0	0	1	0	93
*St. Thomas	"	98 min.	30	0	4	0	3	0	3	0	2	0	39	0	n/a	n/a	11	0	0	0	0	0	1	0	0	0	0	0	0	0	93
*Cobourg	"	128 min.	14	0	3	0	1	0	1	0	4	0	39	0	n/a	n/a	7	0	0	0	0	0	2	0	0	0	0	0	0	0	71
Halton Hills	"	56 min.	1	19	1	4	0	3	2	5	2	5	16	42	n/a	n/a	1	12	0	0	0	0	0	2	0	0	0	0	0	2	117
Stratford	"	69 min.	1	14	1	3	0	6	1	4	1	3	12	32	n/a	n/a	2	30	0	0	0	0	1	4	0	0	0	0	0	0	115
*North Bay	"	314 min.	0	0	2	0	1	0	1	0	6	0	39	0	n/a	n/a	4	0	0	0	0	0	0	0	0	0	0	0	2	0	55
*Peterborough	"	161 min.	0	0	3	0	0	0	2	0	2	0	39	0	n/a	n/a	7	0	0	0	1	0	1	0	0	0	0	0	0	0	55
*Sudbury	"	347 min.	0	0	1	0	1	0	1	0	4	0	19	0	n/a	n/a	2	0	0	0	1	0	2	0	0	0	0	0	0	0	31
Grimsby	"	40 min.	0	0	1	3	0	0	0	3	1	3	16	42	n/a	n/a	0	7	0	0	0	0	0	0	0	0	0	0	0	0	76
*Huntsville	"	209 min.	0	0	2	0	0	0	0	1	2	0	0	0	n/a	n/a	7	0	0	0	0	0	2	0	0	0	0	0	0	0	14
*Lindsay	"	146 min.	2	0	2	0	0	0	0	1	6	0	0	0	n/a	n/a	2	0	0	0	0	0	2	0	0	0	0	0	0	0	15
*Owen Sound	"	137 min.	4	0	0	0	1	0	1	0	2	0	19	0	n/a	n/a	2	0	0	0	0	0	0	0	0	0	0	0	0	0	29
Dunnville	"	68 min.	0	0	0	0	0	0	0	1	1	3	4	10	n/a	n/a	0	0	0	0	0	6	0	2	0	0	0	0	0	0	27
Orangeville	"	79 min.	0	0	0	3	0	0	0	2	1	3	4	10	n/a	n/a	1	14	0	0	0	0	0	0	0	0	0	0	0	0	38
*Walkerton	"	110 min.	0	0	0	0	0	0	0	1	0	0	10	0	n/a	n/a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
			333	1,684	168	492	309	558	152	289	1,224	1,763	4,949	8,315			340	2,293	11	69	32	733	576	834	20	24			28	53	25,269

*Full truck loads only

MOVEMENTS TO CONSOLIDATION POINTS
(volume = tonnes)
OWMC WASTE STREAM

Municipality	Consolidation Point	1 Vol.	1 #	2 Vol.	2 #	3 Vol.	3 #	4 Vol.	4 #	5 Vol.	5 #	6 Vol.	6 #	7 Vol.	7 #	8 Vol.	8 #	9 Vol.	9 #	10 Vol.	10 #	11 Vol.	11 #	12 Vol.	12 #	13 Vol.	13 #	14 Vol.	14 #	Total Trips
Ottawa	Cornwall	220	26	55	8	46	6	56	6	125	13	1,839	147			310	42	0	0	129	14	78	7	0		0		17	2	271
Hawkesbury	Cornwall	0	0	0	0	0	0	20	2	96	5	463	21			0	0	0	0	28	3	49	5	0	0	0	0	0	0	46
Total to Cornwall		220		55		46		76		221		2,302				310				157		127						17		317
Kirkland Lake	North Bay	0		0		0		20	1	627	25	1,619	65			53	2	0		83	3	195	8	0		0		0		104
Cochrane	North Bay	0	0	26	1	23	1	7	1	96	4	231	9			160	6	0		0		0		0		0		0		22
Total to North Bay				26	1	23	1	27	2	723	29	1,850	74			213	8			83	3	195	8							126
Chatham	Sarnia	559	65	32	4	109	14	31	3	125	13	1,313	105			265	36	0	0	55	6	52	5	0		0		0		252
Total to Sarnia		559		32		109		31		125		1,313				265				55		52								252

CONSOLIDATION POINT TO TREATMENT FACILITY
NUMBER OF 'TRUCKLOADS'*
OWMC WASTE STREAM

Consolidation Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
Cornwall	9	2	2	3	9	92		12	0	6	5				140
North Bay	0	1	1	1	29	74		9	0	3	8				126
Sarnia	22	1	4	1	5	53		11	0	2	2				107

*Truckload = 25 tonnes

TABLE A.8

LINKS OF THE TRANSPORTATION NETWORK

Ref. No.	From	To	Distance (km)	Time (min.)	Accident Rate*
		***** QEW *****			
QEW-1	St. Catharines - Niagara St.-IC	Grimsby-Ontario St.-IC	27.1	18	.6
QEW-2	Grimsby-Ontario St.-IC	Hamilton-Hwy 20-IC	16.7	11	.5
QEW-3	Hamilton-Hwy 20-IC	Burlington-Hwy 403-IC	12.4	6	1.1
QEW-4	Burlington-Hwy 403-IC	Oakville-Kerr St.-IC	16.2	11	.7
QEW-5	Oakville-Kerr St.-IC	Mississauga-Hwy 10-IC	16.1	11	.8
QEW-6	Mississauga-Hwy 10-IC	Toronto-Hwy 404-IC	26.1	31	.9
		***** HIGHWAY 2 *****			
2-1	Hwy 401-IC	Woodstock-Hwy 59	7.4	6	3.1
		***** HIGHWAY 3 *****			
3-1	Dunnville	Highway 56	21.7	19	3.0
3-2	Nanticoke-Hwy 6	Simcoe-Hwy 24	18.4	13	.7
		***** HIGHWAY 4 *****			
4-1	Hwy 401-IC	St. Thomas	10.8	7	1.9
		***** HIGHWAY 6 *****			
6-1	Nanticoke	E Jct Hwy 403-IC	55.1	47	.8
6-2	E Jct Hwy 403	Disposal Site	19.5	17	1.1
6-3	Disposal Site	E Jct Hwy 401	4.2	5	1.2
6-4	W Jct Hwy 401	Guelph-College Ave.	11.8	10	1.0
6-5	Guelph-College Ave.	Arthur	44.9	38	.9
6-6	Arthur	Owen Sound	94.3	81	.6
		***** HIGHWAY 7 *****			
7-1	Hwy 417-IC	Actinolite-Hwy 37	154.2	132	.8
7-2	Peterborough E Jct Hwy 7B	Five Mile Corners S Jct Hwy 28	12.6	15	2.6
7-3	Georgetown	Guelph-IC 7&6	44.3	38	1.8

* Truck accidents per million km of travel.

Source: Truck Transportation Office, Ministry of Transportation and Communications.

TABLE A.8 (continued)

LINKS OF THE TRANSPORTATION NETWORK

Ref. No.	From	To	Distance (km)	Time (min.)	Accident Rate*
		***** HIGHWAY 8 *****			
8-1	Hwy 401 .	Kitchener-Waterloo Expressway-IC	7.5	9	.8
8-2	Kitchener-Waterloo Expressway-IC	Stratford 7&8-IC	46.7	40	.8
		***** HIGHWAY 9 *****			
9-1	Arthur-Hwy 6	Walkerton-Jct 4	63.2	54	.8
		***** HIGHWAY 10 *****			
10-1	Hwy 401	Brampton Hwy 7	11.9	14	1.4
10-2	Brampton Hwy 7	Orangeville	35.9	31	1.0
		***** HIGHWAY 11 *****			
11-1	Hwy 401	Aurora	29.2	25	1.7
11-2	Hwy 93 & Hwy 400	Huntsville Jct Hwy 60	122.0	105	.7
11-3	Huntsville Jct Hwy 60	North Bay, Trout Lake Rd.	122.7	105	1.5
11-4	North Bay, Trout Lake Rd.	Kirkland Lake Jct Hwy 66	238.2	204	1.8
11-5	Kirkland Lake Jct Hwy 66	Cochrane Jct Hwy 579	137.7	118	1.3
		***** HIGHWAY 17 *****			
17-1	North Bay, Trout Lake Rd.	Sudbury Hwy 69	123.1	106	1.3
17-2	Sudbury Hwy 69	Sault Ste. Marie, Pim St.	306.8	263	1.0
17-3	Sault Ste. Marie, Pim St.	Thunder Bay Jct Hwy 102	704.4	603	1.8
		***** HIGHWAY 28 *****			
28-1	Jct Hwy 7	Hwy 401-IC	33.5	29	1.1
		***** HIGHWAY 34 *****			
34-1	Hawkesbury Hwy 17	Lancaster Hwy 401	59.3	51	1.5
		***** HIGHWAY 35 *****			
35-1	Lindsay N Jct Hwy 7	Hwy 401-IC	55.6	48	1.5

* Truck accidents per million km of travel.

Source: Truck Transportation Office, Ministry of Transportation and Communications.

TABLE A.8 (continued)

LINKS OF THE TRANSPORTATION NETWORK

Ref. No.	From	To	Distance (km)	Time (min.)	Accident Rate*
		***** HIGHWAY 37 *****			
37-1	Belleville	Hwy 401-IC	4.6	6	1.2
37-2	Hwy 401-IC	Jct Hwy 7	44	38	.9
		***** HIGHWAY 40 *****			
40-1	Hwy 401-IC	Chatham Jct Hwy 2	15.2	13	1.2
40-2	Jct Hwy 2	Sarnia Hwy 402-IC	77.7	67	1.7
		***** HIGHWAY 45 *****			
45-1	Cobourg Jct Hwy 2	Hwy 401-IC	4	5	1.8
		***** HIGHWAY 53 *****			
53-1	Hwy 403 W Jct	Brantford Hwy 24 Jct	21.2	18	1.7
		***** HIGHWAY 56 *****			
56-1	Jct Hwy 3	Hamilton QEW	23.8	20	.5
		***** HIGHWAY 69 *****			
69-1	Hwy 400 & 12-IC	Sudbury, Loach Rd.	245.6	210	1.6
		***** HIGHWAY 126 *****			
126-1	Hwy 401-IC	London Jct Hwy 2&4	9	11	.9
		***** HIGHWAY 138 *****			
138-1	Cornwall Jct Hwy 2	Hwy 401-IC	4.5	5	1.8
138-2	Hwy 401-IC	Hwy 417-IC	29.8	26	.9
		***** HIGHWAY 400 *****			
400-1	Hwy 401-IC	Toronto, Finch St.	4.5	5	1.8
400-2	Toronto, Finch St.	Barrie, Dunlop St.	71.6	48	.6
400-3	Barrie, Dunlop St.	Hwy 11-IC	7.8	5	1.1
400-4	Hwy 11-IC	Hwys 12/69-IC	42.2	28	1.0
		***** HIGHWAY 401 *****			
401-1	Lancaster Hwys 2/34-IC	Cornwall Hwy 138-IC	24.3	16	.4
401-2	Cornwall Hwy 138-IC	Brockville Hwy 29-IC	92.8	62	.6
401-3	Brockville Hwy 29-IC	Kingston, Division St.	79.4	53	.5

* Truck accidents per million km of travel.

Source: Truck Transportation Office, Ministry of Transportation and Communications.

TABLE A.8 (continued)

LINKS OF THE TRANSPORTATION NETWORK

Ref. No.	From	To	Distance (km)	Time (min.)	Accident Rate*
401-4	Kingston, Division St.	Belleville Hwy 37-IC	73.5	49	.7
401-5	Belleville Hwy 37-IC	Cobourg, Division St.	69.6	46	.4
401-6	Cobourg, Division St.	Port Hope Hwy 28-IC	9.5	6	.2
401-7	Port Hope Hwy 28-IC	Newcastle Hwy 35-IC	28.6	19	.4
401-8	Newcastle Hwy 35-IC	Oshawa, Park Rd. S.	19.8	13	.6
401-9	Oshawa, Park Rd. S.	Toronto, Yonge St. (Hwy 11)	47.9	32	.7
401-10	Toronto, Yonge St.	Hwy 400-IC	10.1	7	1.5
401-11	Hwy 400-IC	Hwy 10-IC	17.7	12	1.5
401-12	Hwy 10-IC	Milton Hwy 25-IC	22.4	15	.4
401-13	Milton Hwy 25-IC	Hwy 6 E-IC	20.3	14	.5
401-14	Hwy 6 E-IC	Hwy 6 W-IC	4.3	3	.3
401-15	Hwy 6 W-IC	Hwy 8-IC	17.4	12	.3
401-16	Hwy 8-IC	Hwys 2&53-IC	39.9	27	.3
401-17	Hwys 2&53-IC	London Hwy 126	50.0	33	.4
401-18	London Hwy 126	Hwy 402-IC	5.9	4	.3
401-19	Hwy 402-IC	St. Thomas Hwy 4	10.8	7	.5
401-20	St. Thomas Hwy 4	Chatham Hwy 40	84.5	56	.5
401-21	Chatham Hwy 40	Windsor Hwy 2	76.5	51	.3
		***** HIGHWAY 402 *****			
402-1	Hwy 401-IC	Sarnia Hwy 40B	101.7	68	1.2
		***** HIGHWAY 403 *****			
403-1	Burlington, QEW-IC	Hwy 6-IC	8.9	6	.4
403-2	Hwy 6-IC	Hwy 53 Jct	16.6	11	.7
		***** HIGHWAY 406 *****			
406-1	Welland	St. Catharines QEW-IC	28.7	34	2.1
		***** HIGHWAY 417 *****			
417-1	Hwy 138-IC	Ottawa Hwy 31-IC	62.9	42	.4
417-2	Ottawa Hwy 31-IC	Hwy 7 Jct	25.2	22	.7
		***** MISCELLANEOUS *****			
M-1	Kingston	Hwy 401-IC	5	6	2.0

* Truck accidents per million km of travel.

Source: Truck Transportation Office, Ministry of Transportation and Communications.

TABLE A.9

TRAVEL TIME AND DISTANCES
LIQUIDS & SLUDGES
LOW VOLUME SCENARIO

MUNICIPALITY	A Shipments Liquids & Sludges	B Trip Distance (km)	C Total Distance (km)	D Trip Time (min.)	E Total Trip Time (min.)	F In-Town Travel Time (min.)	G Total Travel Time (min.)
Hamilton	1387	40.8	56589.6	29	40223	41610	81833
Toronto N	1077	69.1	74420.7	46	49542	32310	81852
Toronto S	1077	87.8	94560.6	76	81852	32310	114162
Sault Ste. Marie	190	743.1	141189	605	114950	2850	117800
Mississauga	618	61.7	38130.6	45	27810	18540	46350
Kitchener	542	33.4	18102.8	29	15718	8130	23848
Windsor	281	293.5	82473.5	198	55638	4215	59853
Welland	375	113.3	42487.5	92	34500	5625	40125
Brampton	371	58.9	21851.9	48	17808	5565	23373
Sarnia	245	223.4	54733	152	37240	3675	40915
St. Catharines	222	84.6	18781.2	58	12876	3330	16206
Oshawa	335	122.6	41071	85	28475	5025	33500
Aurora	249	103.9	25871.1	78	19422	3735	23157
Thunder Bay	32	1447.5	46320	1208	38656	480	39136
London	223	124.8	27830.4	91	20293	3345	23638
Barrie	61	140.7	8582.7	99	6039	915	6954
Oakville	190	44.6	8474	34	6460	2850	9310
Cornwall	98	482.6	47294.8	338	33124	1470	34594
Guelph	118	20.3	2395.4	18	2124	1770	3894
Ottawa	26	484.9	12607.4	361	9386	390	9776
Simcoe	81	93.0	7533	77	6237	1215	7452
Kingston	53	328.6	17415.8	224	11872	795	12667
Woodstock	112	73.2	8198.4	53	5936	1680	7616
Chatham	20	232.2	4644	160	3200	300	3500
Brantford	88	57.3	5042.4	46	3996	1320	5368
Brockville	38	403.0	15314	279	10602	570	11172
Belleville	35	254.7	8914.5	175	6125	525	6650
St. Thomas	30	143.3	4299	98	2940	450	3390
Cobourg	24	184.5	4428	128	3072	360	3432
Halton Hills	44	64.6	2842.4	56	2464	660	3124
Stratford	37	80.1	2963.7	69	2553	555	3108
North Bay	62	393.7	24409.4	314	19468	930	20398
Peterborough	21	217.1	4559.1	161	3381	315	3696
Sudbury	14	436.3	6108.2	347	4858	210	5068
Grimsby	30	57.5	1725	40	1200	450	1650
Huntsville	6	271.7	1630.2	209	1254	90	1344
Lindsay	9	198.0	1782	146	1314	135	1449
Owen Sound	12	159.5	1914	137	1644	180	1824
Dunnville	11	77.4	851.4	68	748	165	913
Orangeville	17	94.7	1609.9	79	1343	255	1598
Walkerton	5	128.4	642	110	550	75	625
Total	8466		990593.4				936320

Source of the Columns: Column A, Table A.5; Column B, Table 3.10; Column C, Column A x B; Column D, Table 3.10; Column E, Column A x D; Column F, In Town Travel x Column A; Column G, Column E + F.

TABLE A.10

TRAVEL TIME AND DISTANCES
LIQUIDS & SLUDGES
MEDIUM VOLUME SCENARIO

MUNICIPALITY	A Shipments Liquids & Sludges	B Trip Distance (km)	C Total Distance (km)	D Trip Time (min.)	E Total Trip Time (min.)	F In-Town Travel Time (min.)	G Total Travel Time (min.)
Hamilton	2816	40.8	114892.8	29	81664	84480	166144
Toronto N	1934	69.1	133639.4	46	88964	58020	146984
Toronto S	1934	87.8	169805.2	76	146984	58020	205004
Sault Ste. Marie	387	743.1	287579.7	605	234135	5805	239940
Mississauga	1086	61.7	67006.2	45	48870	32580	81450
Kitchener	976	33.4	32598.4	29	28304	14680	42944
Windsor	524	293.5	153794	198	103752	7860	111612
Welland	693	113.3	78516.9	92	63756	10395	74151
Brampton	658	58.9	38756.2	48	31584	9870	41454
Sarnia	432	223.4	96508.8	152	65664	6480	72144
St. Catharines	407	84.6	34432.2	58	23606	6105	29711
Oshawa	658	122.6	80670.8	85	55930	9870	65800
Aurora	422	103.9	43845.8	78	32916	6330	39246
Thunder Bay	52	1447.5	75270	1208	62816	780	63596
London	386	124.8	48172.8	91	35126	5790	40916
Barrie	115	140.7	16180.5	99	11385	1725	13110
Oakville	353	44.6	15743.8	34	12002	5295	17297
Cornwall	152	482.6	73355.2	338	51376	2280	53656
Guelph	206	20.3	4181.8	18	3708	3090	6798
Ottawa	48	484.9	23275.2	361	17328	720	18048
Simcoe	160	93.0	14880	77	12320	2400	14720
Kingston	95	328.6	31217	224	21280	1425	22705
Woodstock	190	73.2	13908	53	10070	2850	12920
Chatham	35	232.2	8127	160	5600	525	6125
Brantford	147	57.3	8423.1	46	6762	2205	8967
Brockville	59	403.0	23777	279	16461	885	17346
Belleville	57	254.7	14517.9	175	9975	855	10830
St. Thomas	52	143.3	7451.6	98	5096	780	5876
Cobourg	42	184.5	7749	128	5376	630	6006
Halton Hills	70	64.6	4522	56	3920	1050	4970
Stratford	70	80.1	5607	69	4830	1050	5880
North Bay	109	393.7	42913.3	314	34226	1635	35861
Peterborough	33	217.1	7164.3	161	5313	495	5808
Sudbury	19	436.3	8289.7	347	6593	285	6878
Grimsby	47	57.5	2702.5	40	1880	705	2585
Huntsville	9	271.7	2445.3	209	1881	135	2016
Lindsay	9	198.0	1782	146	1314	135	1449
Owen Sound	17	159.5	2711.5	137	2329	255	2584
Dunnville	17	77.4	1315.8	68	1156	255	1411
Orangeville	24	94.7	2272.8	79	1896	360	2256
Walkerton	7	128.4	898.8	110	770	105	875
Total	15507		1800901.3				1708073

Source of the Columns: Column A, Table A.6; Column B, Table 3.10; Column C, Column A x B; Column D, Table 3.10; Column E, Column A x D; Column F, In Town Travel x Column A; Column G, Column E + F.

TABLE A.11

TRAVEL TIME AND DISTANCES
LIQUIDS & SLUDGES
HIGH VOLUME SCENARIO

MUNICIPALITY	A Shipments Liquids & Sludges	B Trip Distance (km)	C Total Distance (km)	D Trip Time (min.)	E Total Trip Time (min.)	F In-Town Travel Time (min.)	G Total Travel Time (min.)
Hamilton	4565	40.8	186252	29	132385	136950	269335
Toronto N	3212	69.1	221949.2	46	147752	96360	244112
Toronto S	3212	87.8	282013.6	76	244112	96360	340472
Sault Ste. Marie	646	743.1	480042.6	605	390830	9690	400520
Mississauga	1806	61.7	111430.2	45	81270	54180	135450
Kitchener	1624	33.4	54241.6	29	47096	24360	71456
Windsor	870	293.5	255345	198	172260	13050	185310
Welland	1142	113.3	129388.6	92	105064	17130	122194
Brampton	1086	58.9	63965.4	48	52128	16290	68418
Sarnia	714	223.4	159507.6	152	108528	10710	119238
St. Catharines	676	84.6	57189.6	58	39208	10140	49348
Oshawa	1088	122.6	133388.8	85	92480	16320	108800
Aurora	722	103.9	75015.8	78	56316	10830	67146
Thunder Bay	84	1447.5	121590	1208	101472	1260	102732
London	637	124.8	79497.6	91	57967	9555	67522
Barrie	192	140.7	27014.4	99	19008	2880	21888
Oakville	587	44.6	26180.2	34	19958	8805	28763
Cornwall	249	482.6	120167.4	338	84162	3735	87897
Guelph	340	20.3	6902	18	6120	5100	11220
Ottawa	80	484.9	39192	361	28880	1200	30080
Simcoe	256	93.0	23808	77	19712	3840	23552
Kingston	160	328.6	52576	224	35840	2400	38240
Woodstock	318	73.2	23277.6	53	16854	4770	21624
Chatham	56	232.2	13003.2	160	50880	840	51720
Brantford	248	57.3	14210.4	46	11408	3720	15128
Brockville	100	403.0	40300	279	27900	1500	29400
Belleville	93	254.7	23687.1	175	16275	1395	17670
St. Thomas	93	143.3	13326.9	98	9114	1395	10509
Cobourg	71	184.5	13099.5	128	9088	1065	10153
Halton Hills	117	64.6	7558.2	56	6552	1755	8307
Stratford	115	80.1	9211.5	69	7935	1725	9660
North Bay	181	393.7	71259.7	314	56834	2715	59549
Peterborough	55	217.1	11940.5	161	8855	825	9680
Sudbury	31	436.3	13525.3	347	10757	465	11222
Grimsby	76	57.5	4370	40	3040	1140	4180
Huntsville	14	271.7	3803.8	209	2926	210	3136
Lindsay	15	198.0	2970	146	2190	225	2415
Owen Sound	29	159.5	4625.5	137	3973	435	4408
Dunnville	27	77.4	11582.8	68	1836	405	2241
Orangeville	38	94.7	3598.6	79	3002	570	3572
Walkerton	11	128.4	1412.4	110	1210	165	1375
Total	25636		2993420.6				2869642

Source of the Columns: Column A, Table A.7; Column B, Table 3.10; Column C, Column A x B; Column D, Table 3.10; Column E, Column A x D; Column F, In Town Travel x Column A; Column G, Column E + F.

TABLE A.12

TRAVEL TIME AND DISTANCES
LIQUIDS AND SLUDGES
TO CONSOLIDATION POINTS

				Low Volume Scenario					Medium Volume Scenario					High Volume Scenario				
Source	Destination	Trip Length	Trip Time	# of Trips	Total Distance	Travel Time	In-Town Travel Time	Total Travel Time	# of Trips	Total Distance	Travel Time	In-Town Travel Time	Total Travel Time	# of Trips	Total Distance	Travel Time	In-Town Travel Time	Total Travel Time
Ottawa	Cornwall	92.7	68	85	7,879.5	5,780	1,275	7,055	164	15,202.8	11,152	2,460	13,612	271	25,121.7	18,428	4,065	22,493
Hawkesbury	Cornwall	88.1	72	17	1,497.7	1,224	255	1,479	29	2,554.9	2,088	435	2,523	46	4,052.6	3,312	690	4,002
Kirkland Lake	North Bay	238.2	204	34	8,098.8	6,936	510	7,446	63	15,006.6	12,852	945	13,797	104	24,772.8	21,216	1,560	22,776
Cochrane	North Bay	375.9	322	9	3,383.1	2,898	135	3,033	15	5,638.5	4,830	225	5,055	22	8,269.8	7,084	330	7,414
Chatham	Sarnia	77.7	67	78	6,060.6	5,226	1,170	6,396	152	11,810.4	10,184	2,280	12,464	252	19,580.4	16,884	3,780	20,664
Total					26,919.7			25,409		50,213.2			47,451		81,797.3			77,349

Trip length and trip travel time are found in Table 3.10. Number of shipments are in Tables A.5, A.6 and A.7 for the low, medium and high volume scenario respectively.

TABLE A.13

TRAVEL TIME AND DISTANCES
SOLIDS

MUNICIPALITY	Low Volume Scenario							Medium Volume Scenario					High Volume Scenario				
	Trip Distance	Trip Time	Ship-ments	Total Distance	Trip Time	In-Town Travel	Total Time	Ship-ments	Total Distance	Trip Time	In-Town Travel	Total Time	Ship-ments	Total Distance	Trip Time	In-Town Travel	Total Time
Hamilton	40.8	29	233	9,506.4	6,757	6,990	13,747	840	34,272	24,360	25,200	49,560	1,395	56,916	40,455	41,850	82,305
Toronto N	69.1	46	13	898.3	598	390	988	46	3,178.6	2,116	1,380	3,496	77	5,320.7	3,542	1,155	4,697
Toronto S	87.8	76	13	1,141.4	988	390	1,378	46	4,038.8	3,496	1,380	4,876	77	6,760.6	5,852	1,155	7,007
Sault Ste. Marie	743.1	605	91	67,622.1	55,055	1,365	56,420	329	244,479.9	199,045	4,935	203,980	547	406,475.7	330,935	8,205	339,140
Mississauga	61.7	45	5	308.5	225	150	375	19	1,172.3	855	285	1,140	31	1,912.7	1,395	465	1,860
Kitchener	33.4	29	15	501	435	225	660	53	1,770.2	1,537	795	2,332	88	2,939.2	2,552	1,320	3,872
Windsor	293.5	198	4	1,174	792	60	852	15	4,402.5	2,970	225	3,195	25	7,337.5	4,950	375	5,325
Welland	113.3	92	31	3,512.3	2,852	465	3,317	112	12,689.6	10,304	1,680	11,984	185	20,960.5	17,020	2,775	19,795
Brampton	58.9	48	5	294.5	240	75	315	17	1,001.3	816	255	1,071	28	1,649.2	1,344	420	1,764
Sarnia	223.4	152	3	670.2	456	45	501	11	2,457.4	1,672	165	1,837	19	4,244.6	2,888	285	3,173
St. Catharines	84.6	58	18	1,522.8	1,044	270	1,314	66	5,583.6	3,828	990	4,818	110	9,306	6,380	1,650	8,030
Oshawa	122.6	85	8	980.8	680	120	800	28	3,432.8	2,380	420	2,800	47	5,762.2	3,995	705	4,700
Aurora	103.9	78	2	207.8	156	30	186	5	519.5	390	75	465	9	935.1	702	135	837
Thunder Bay	1,447.5	1,208	1	1,447.5	1,208	15	1,223	4	5,790	4,832	60	4,892	6	8,685	7,248	90	7,338
London	124.8	91	6	748.8	546	90	636	21	2,620.8	1,911	315	2,226	35	4,368	3,185	525	3,710
Barrie	140.7	99	18	2,532.6	1,782	270	2,052	64	9,004.8	6,336	960	7,296	107	15,054.9	10,593	1,605	12,198
Oakville	44.6	34	1	44.6	34	15	49	4	178.4	136	60	196	6	267.6	204	90	294
Cornwall	482.6	338	1	482.6	338	15	353	2	965.2	676	30	706	3	1,447.8	1,014	45	1,059
Guelph	20.3	18	3	60.9	54	45	99	9	182.7	162	135	297	16	324.8	288	240	528
Ottawa	484.9	361	3	1,454.7	1,083	45	1,128	11	5,333.9	3,971	165	4,136	19	9,213.1	6,859	285	7,144
Simcoe	93	77	10	930	770	150	920	36	3,348	2,772	540	3,312	60	5,580	4,620	900	5,520
Kingston	328.6	224	8	2,628.8	1,792	120	1,912	28	9,200.8	6,272	420	6,692	47	15,444.2	10,528	205	10,733
Cochrane	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Woodstock	73.2	53	2	146.4	106	30	136	8	585.6	424	120	544	13	951.6	689	195	884
Chatham	232.2	160	2	464.4	320	30	350	8	1,857.6	1,280	120	1,400	13	3,018.6	2,080	195	2,275
Kirkland Lake	631.9	518	4	2,527.6	2,072	60	2,132	16	10,110.4	8,288	240	8,528	26	16,429.4	13,468	390	13,858
Brantford	57.3	46	1	57.3	46	15	61	2	114.6	104	30	122	3	171.9	136	45	183
Brockville	403	279	1	403	279	15	294	4	1,612	1,116	60	1,176	6	2,416	1,674	90	1,764
Belleville	254.7	175	1	254.7	175	15	190	2	309.4	380	30	583	3	764.1	525	45	570
St. Thomas	143.3	98	1	143.3	98	15	113	2	286.6	196	30	226	3	429.9	294	45	339
Cobourg	184.5	128	1	184.5	128	15	143	4	738	512	60	572	6	1,107	768	90	858
Halton Hills	64.6	56	1	64.6	56	15	71	2	129.2	112	30	142	3	193.8	168	45	213
Stratford	80.1	69	2	160.2	138	30	168	6	480.6	414	90	504	9	720.9	621	135	756
North Bay	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Peterborough	217.1	161	1	217.1	161	15	176	2	434.2	322	30	352	3	651.3	483	45	528
Sudbury	436.3	347	1	436.3	347	15	362	4	1,745.2	1,388	60	1,448	6	3,031.8	2,082	90	2,172
Grimsby	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Hawkesbury	588.4	410	1	588.4	410	15	425	4	2,353.6	1,640	60	1,700	6	3,530.4	2,460	90	2,550
Huntsville	271.7	209	1	271.7	209	15	234	4	10,868	836	60	896	6	1,630.2	1,254	90	1,344
Lindsay	198	146	1	198	146	15	161	4	792	584	60	644	6	1,188	876	90	966
Owen Sound	139.5	137	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dunnville	77.4	68	1	77.4	68	15	83	2	154.8	136	30	166	3	232.2	204	45	249
Orangeville	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Walkerton	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total				104,865.4			94,324		378,614			340,315		627,372.5			560,538

Trip distances and travel times are from Table 3.10. Shipments are from Table 3.5. Total distance is equal to shipments multiplied by trip distance. Total time is equal to shipments multiplied by travel time plus shipments multiplied by in-town travel.

TABLE A.10

YEARLY TRUCK ARRIVALS AT THE TREATMENT FACILITY

OWMC WASTE STREAM

	1		2		3		4		5		6		7		8		9		10		11		12		13		14		TOTAL	
	TL	LTL	TL	LTL	TL	LTL	TL	LTL	TL	LTL	TL	LTL	TL	LTL	TL	LTL	TL	LTL	TL	LTL	TL	LTL	TL	LTL	TL	LTL	TL	LTL	TL	LTL
Low Volume Scenario																														
Liquids and Sludges	92	381	70	176	103	219	121	231	402	551	1,795	2,895			123	765	8	37	11	183	104	153	0	4	0	0	0	0	2,869	5,597
Solids																					514								514	
Total	92	381	70	176	103	219	121	231	402	551	1,795	2,895			123	765	8	37	11	183	618	153	0	4	0	0	0	0	3,383	5,597
Medium Volume Scenario																														
Liquids and Sludges	218	1,009	103	295	197	336	96	178	761	1,099	3,898	6,990			213	1,361	8	41	36	560	357	512	10	13	0	0	20	32	5,121	10,386
Solids																					1,840								1,840	
Total	218	1,009	103	295	197	336	96	178	761	1,099	3,898	6,990			213	1,361	8	41	36	560	2,197	512	10	13	0	0	20	32	6,961	10,386
High Volume Scenario																														
Liquids and Sludges	364	1,684	172	492	316	558	157	289	1,267	1,763	5,168	8,315			372	2,293	11	69	43	733	591	854	20	26	0	0	28	53	8,509	17,127
Solids																					3,057								3,057	
Total	364	1,684	172	492	316	558	157	289	1,267	1,763	5,168	8,315			372	2,293	11	69	43	733	3,648	854	20	26	0	0	28	53	11,566	17,127

TABLE A.15

FOR-HIRE TRANSPORTATION COSTS
LIQUIDS & SLUDGES
FROM MUNICIPALITIES TO TREATMENT FACILITY
(rounded to nearest $1,000)

MUNICIPALITY	Low Volume	Medium Volume	High Volume
Hamilton	$ 298,000	$ 605,000	$ 981,000
Toronto N	253,000	455,000	755,000
Toronto S	292,000	524,000	871,000
Sault Ste. Marie	169,000	344,000	574,000
Mississauga	145,000	254,000	423,000
Kitchener	107,000	192,000	320,000
Windsor	112,000	209,000	348,000
Welland	102,000	189,000	311,000
Brampton	81,000	144,000	238,000
Sarnia	84,000	149,000	246,000
St. Catharines	51,000	94,000	157,000
Oshawa	88,000	174,000	287,000
Aurora	64,000	108,000	185,000
Thunder Bay	52,000	84,000	135,000
London	60,000	105,000	173,000
Barrie	17,000	32,000	54,000
Oakville	38,000	72,000	119,000
Cornwall	56,000	86,000	141,000
Guelph	22,000	38,000	62,000
Ottawa	15,000	29,000	48,000
Simcoe	21,000	41,000	65,000
Kingston	23,000	41,000	69,000
Woodstock	25,000	43,000	72,000
Chatham	7,000	12,000	70,000
Brantford	19,000	32,000	54,000
Brockville	19,000	29,000	50,000
Belleville	13,000	21,000	35,000
St. Thomas	8,000	15,000	26,000
Cobourg	8,000	13,000	22,000
Halton Hills	10,000	16,000	27,000
Stratford	9,000	17,000	28,000
North Bay	33,000	59,000	98,000
Peterborough	7,000	12,000	20,000
Sudbury	8,000	11,000	18,000
Grimsby	6,000	10,000	16,000
Huntsville	2,000	4,000	6,000
Lindsay	3,000	3,000	5,000
Owen Sound	4,000	6,000	9,000
Dunnville	3,000	4,000	7,000
Orangeville	4,000	6,000	10,000
Walkerton	1,000	2,000	3,000
TOTAL	$2,339,000	$4,284,000	$7,138,000

These figures are calculated by multiplying total time from Tables A.9, A.10, and A.11 by $72.00 and then adding unloading and loading costs.

TABLE A.16

FOR-HIRE TRANSPORTATION COSTS
LIQUIDS & SLUDGES
FROM MUNICIPALITIES TO CONSOLIDATION POINTS
(rounded to the nearest $1,000)

MUNICIPALITY	Consolidation Point	Total Costs		
		Low Volume Scenario	Medium Volume Scenario	High Volume Scenario
Ottawa	Cornwall	$21,000	$ 40,000	$ 66,000
Hawkesbury	Cornwall	4,000	7,000	11,000
Kirkland Lake	North Bay	14,000	26,000	42,000
Cochrane	North Bay	5,000	8,000	12,000
Chatham	Sarnia	19,000	37,000	61,000
TOTAL		$63,000	$118,000	$192,000

These figures are calculated from data in Table A.12. Total time multiplied by $72.00, plus loading and unloading costs.

TABLE A.17

FOR-HIRE TRANSPORTATION COSTS
SOLIDS
FROM MUNICIPALITIES TO TREATMENT FACILITY
(rounded to nearest $100)

MUNICIPALITY	Low Volume	Medium Volume	High Volume
Hamilton	$ 33,300	$ 120,000	$ 199,200
Toronto N	2,100	7,500	11,200
Toronto S	2,600	9,200	14,000
Sault Ste. Marie	74,300	268,500	446,300
Mississauga	800	2,700	4,500
Kitchener	1,900	6,600	11,000
Windsor	1,300	4,900	8,200
Welland	62,100	22,400	37,100
Brampton	700	2,500	4,100
Sarnia	800	3,000	5,200
St. Catharines	2,800	10,500	17,600
Oshawa	1,500	5,400	9,000
Aurora	400	900	1,600
Thunder Bay	1,500	6,200	9,200
London	1,200	4,200	7,000
Barrie	3,800	13,400	22,300
Oakville	100	500	800
Cornwall	500	1,000	1,500
Guelph	300	1,000	1,800
Ottawa	1,600	5,800	15,100
Simcoe	1,800	6,600	10,900
Kingston	2,900	10,000	16,300
Cochrane	—	—	—
Woodstock	300	1,200	2,000
Chatham	600	2,300	3,700
Kirkland Lake	2,800	11,400	18,500
Brantford	100	300	400
Brockville	400	1,700	2,500
Belleville	300	800	1,000
St. Thomas	200	400	600
Cobourg	200	1,000	1,500
Halton Hills	200	300	500
Stratford	300	1,000	1,600
North Bay	—	—	—
Peterborough	300	600	800
Sudbury	500	2,000	3,000
Grimsby	—	—	—
Hawkesbury	600	2,300	3,500
Huntsville	400	1,400	2,000
Lindsay	300	1,100	1,600
Owen Sound	—	—	—
Dunnville	200	300	500
Orangeville	—	—	—
Walkerton	—	—	—
TOTAL	$ 206,000	$ 540,900	$ 879,100

These data are calculated from total time in Table A.13 multiplied by $72.00 plus loading and unloading costs.

TABLE A.18

SUMMARY OF FOR-HIRE TRANSPORTATION COSTS
(rounded to the nearest $1,000)

TRANSPORTATION COSTS	Low Volume Scenario	Medium Volume Scenario	High Volume Scenario
Liquids & Sludges			
Municipalities to Treatment Facility	$2,339,000	$4,284,000	$7,138,000
Municipalities to Consolidation Points	63,000	118,000	192,000
Total Liquids & Sludges	2,402,000	4,402,000	7,330,000
Total Solids	206,000	541,000	879,000
Total Transportation Costs	$2,608,000	$4,943,000	$8,209,000

POOR

QUALITY

ORIGINAL